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FINAL WORK PLAN AND FINAL STATUS SURVEY PLAN RADIUM SITES 12 AND 27 NAS PENSACOLA FL

8/19/2011

ALEUT WORLD SOLUTIONS

ALEUT WORLD SOLUTIONS

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FINAL WORK PLAN AND FINAL STATUS SURVEY PLAN

NAS Pensacola

Radium Sites 12, and 27

Pensacola, FL

For the:

U.S. ARMY JOINT MUNITIONS COMMAND

ROCK ISLAND, IL

Project No. USN 2006-008

Contract No. W52P1J-08-D-0034/DO:0014

August 19, 2011
Rev. 2

Prepared by:

Aleut World Solutions
615 E. 82nd Ave. Suite 200
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Approvals Page

WORK PLAN AND FINAL STATUS SURVEY PLAN

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Mr. Patrick Owens, RASO Representative

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ABBREVIATIONS AND ACRONYMS

ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOC	Areas of Concern
AWS	Aleut World Solutions, LLC
bgs	Below grade surface
BLDG	Building
CDE	Committed Dose Equivalent
CFR	Code of Federal Regulations
cm	Centimeter
cpm	Counts per minute
DCGLs	Derived Concentration Guideline Limits
D&D	Decontamination and Decommissioning
DDE	Deep Dose Equivalent
DOD	Department of Defense
DOT	Department of Transportation
dpm/100 cm^2	disintegrations per 100 square centimeters
DQO	Data Quality Objectives
ε_i	Instrument Efficiency
ε_s	Surface Efficiency Factor
EPA	U.S. Environmental Protection Agency
ft	Feet
ft^2	square feet
FSS	Final Status Survey
HASL-300	Environmental Laboratory Procedures Manual, 28^{th} Edition 1997

HASP	Health and Safety Plan
ISO	International Organization for Standardization
LDE	Lens Dose Equivalent
LLRW	Low Level Radioactive Waste
LUC	Land Use Controls
m	Meter
m^2	square meter
MARSSIM	Multi Agency Radiation Survey & Site Investigation Manual
MDC	Minimum Detectable Concentration
MDCR	Minimal Detectable Count Rate
MSDS	Material Safety Data Sheets
mrem/y	milliRem per year
N/A	Not Applicable
NaI	sodium iodide
NAS	Naval Air Station
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PM	Project Manager
PPE	personal protective equipment
QA	Quality Assurance
QC	Quality Control
RI	Remedial Investigation
Ra-226	Radium-226
RASO	Naval Sea Systems Command Detachment, Radiological Affairs Support Office
ROD	Record of Decision
RSO	Radiation Safety Officer
RWP	Radiation Work Permit

SCTL	Soil Cleanup Target Level
SDE	Shallow Dose Equivalent
SOPs	Standard Operating Procedures
TEDE	Total Effective Dose Equivalent
TLD	thermoluminescent dosimeter
μR/h	micro roentgens per hour
WRS	Wilcoxon Rank Sum Test
y	Year

RECORD OF REVISIONS

Revision Number	Description	Date
0	Draft Work Plan and Final Status Survey Plan	12/11/2009
1	Final Work Plan and Final Status Survey Plan	3/1/2010
2	Final Work Plan and Final Status Survey Plan	08/12/2011

1.0 INTRODUCTION

Aleut World Solutions (AWS) has been contracted by the U.S. Army Joint Munitions Command (JMC) to perform radiological Final Status Surveys following remediation/decontamination of Sites 12, and 27 located at the Naval Air Station Pensacola located in Pensacola, FL. A map showing the location of the Naval Air Station Pensacola is provided in Figure 1 below. A map showing the locations of Sites 12, and 27 is provided in Figure 2 below.

The work is being performed in conjunction with the selected remedy as defined in the Record of Decision (ROD), Operable Unit 2, Naval Ari Station Pensacola, Pensacola, Fl (TTNUS, 2009). The ROD Selected Remedy is to remediate various sites within Operable Unit 2 at NAS Pensacola. Operable Unit 2 is located in the eastern portion of NAS Pensacola.

The selected remedy reduces unacceptable exposures to contaminants in soil and groundwater. The selected remedy for OU 2 includes removal of selected soil areas, and land use controls (LUCs) that will limit exposure to soil, prohibit any residential use activities, limit occupational exposure to groundwater, and restrict the use of groundwater at the sites for potable water purposes.

This revision of the work plan and work to be performed follows the previous revision of this work plan (Revision 1, March 1, 2010) but due to scope of work revisions, this revision of the work plan addresses work to be performed in Sites 12 and 27. The previous revision of the work plan included work to be performed at Site 25 and is not included in this revision.

Figure 1 Naval Air Station Pensacola Location Map

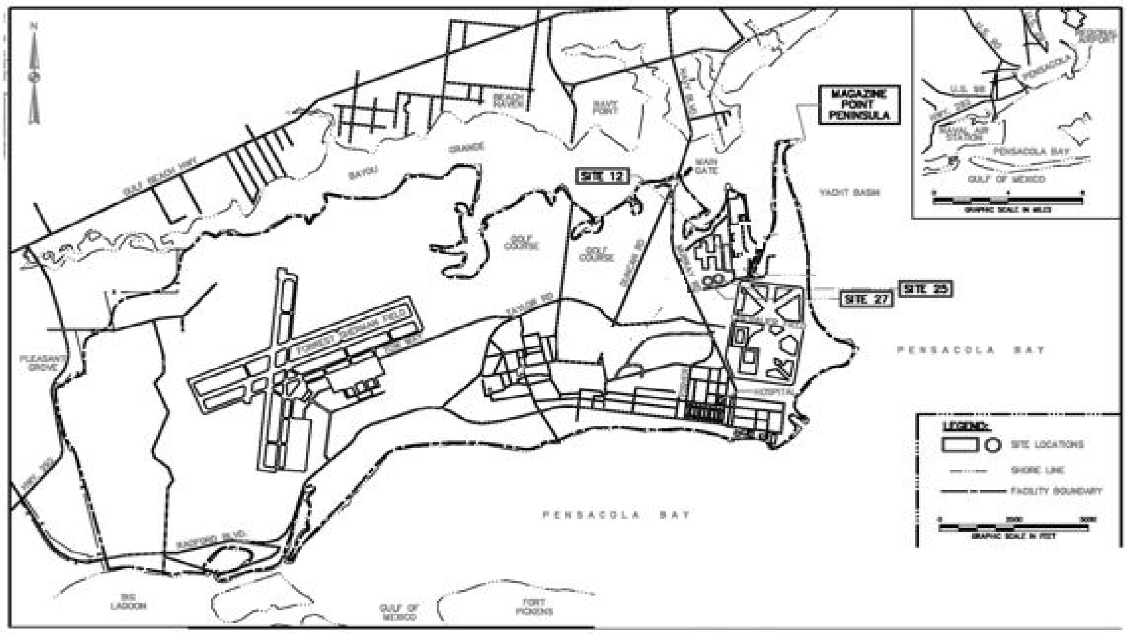
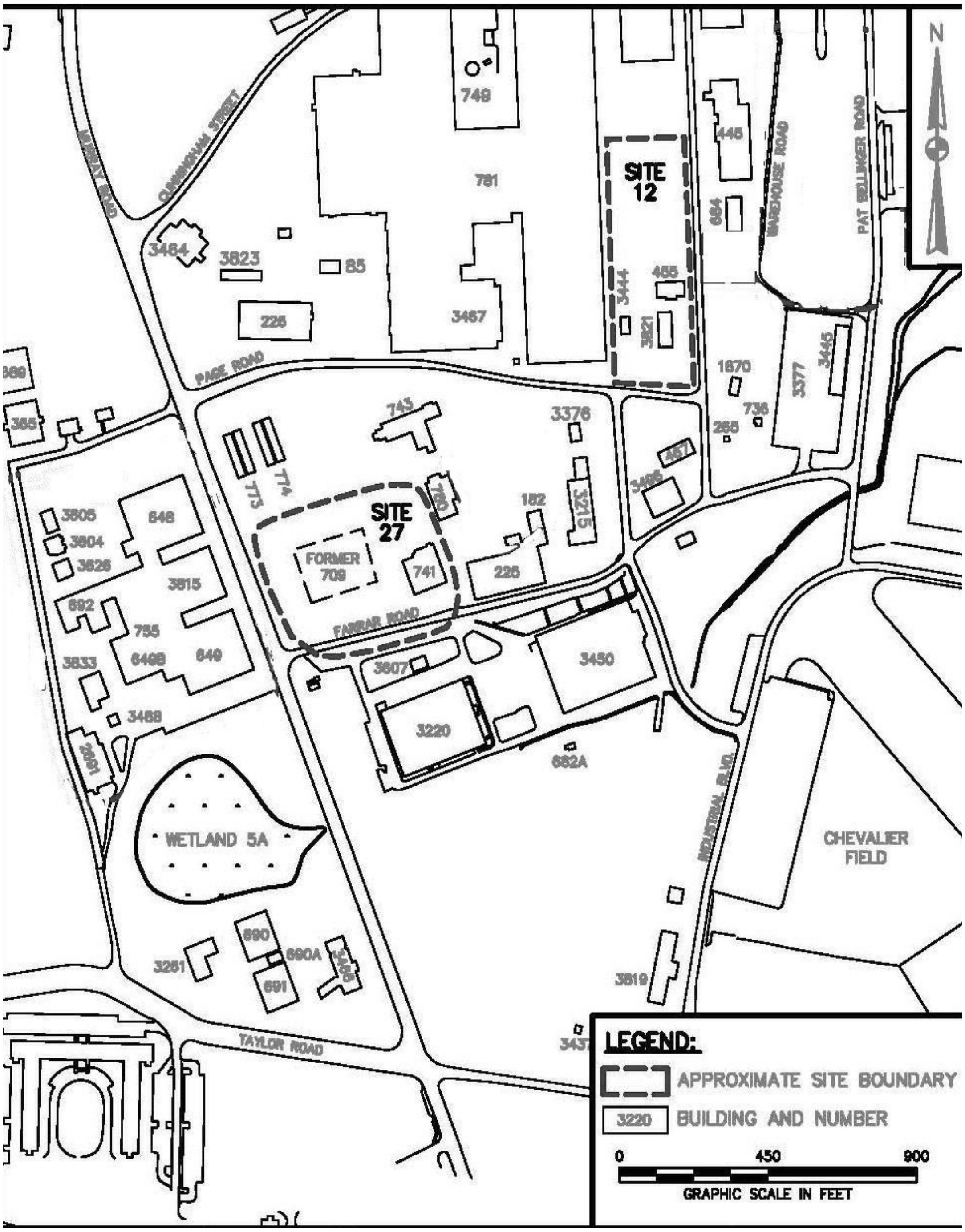


Figure 2 Sites 12, and 27 Location Map



The activities to be performed include:

- Providing a radiation safety briefing to staff assigned to the project who have not previously received a radiation safety briefing.
- Performing incoming equipment and material surveys.
- Excavation down to an estimated maximum of 3-4' below grade surface (bgs) in Sites 12 and 27 and packaging (into DOT approved shipping containers) of radiologically impacted soils.
- Perform final status surveys and sampling in accordance with MARSSIM of Sites 12, and 27
- Providing radiological monitoring during the collection of samples.
- Perform ground water monitoring well sampling.
- Performing personnel surveys while the work is being performed, if necessary.
- Backfilling of excavated areas following final status surveys and sampling activities.
- Performing radiological release surveys on outgoing equipment and material.
- Ship waste materials for disposal.

2.0 PROJECT BACKGROUND INFORMATION

2.1 Facilities

2.1.1 Naval Air Station Pensacola

The site now occupied by Naval Air Station Pensacola has a colorful historical background dating back to the 16th century when Spanish explorer Don Tristan de Luna founded a colony here on the bluff where Fort Barrancas is now situated.

Realizing the advantages of the Pensacola harbor and the large timber reserves nearby for shipbuilding, President John Quincy Adams and Secretary of the Navy Samuel Southard, in 1825, made arrangements to build a Navy yard on the Southern tip of Escambia County, where the air station is today. Navy Captains William Bainbridge, Lewis Warrington, and James Biddle selected the site on Pensacola Bay.

Construction began in April 1826, and the Pensacola Navy Yard became one of the best equipped naval stations in the country. In its early years the base dealt mainly with the suppression of slave trade and piracy in the Gulf and Caribbean.

When New Orleans was captured by Union forces in 1862, Confederate troops, fearing attack from the west, retreated from the Navy Yard and reduced most of the facilities to rubble. After the war, the ruins at the yard were cleared away and work was begun to rebuild the base. Many of the present structures on the air station were built during this period, including the stately two and three-story houses on North Avenue. In 1906, many of these newly rebuilt structures were destroyed by a great hurricane and tidal wave.

Meanwhile, great strides were being made in aviation. The Wright Brothers and especially Glenn Curtiss were trying to prove to the Navy that the airplane had a place in the fleet. The first aircraft carrier was built in January 1911, and a few weeks later, the seaplane made its first appearance. Then, civilian pilot Eugene Ely landed a frail craft aboard USS Pennsylvania in San Francisco Bay, and the value of the airplane to the Navy had been demonstrated.

The Navy Dept., now awakened to the possibilities of Naval Aviation through the efforts of Capt. W. I. Chambers, prevailed upon congress to include in the Naval Appropriation Act enacted in 1911-12 a provision for aeronautical development. Chambers was ordered to devote all of his time to naval aviation.

In October 1913, Secretary of the Navy, Josephus Daniels, appointed a board, with Capt. Chambers as chairman, to make a survey of aeronautical needs and to establish a policy to guide future development. One of the board's most important recommendations was the establishment of an aviation training station in Pensacola.

Upon entry into World War I, Pensacola, still the only naval air station, had 38 naval aviators, 163 enlisted men trained in aviation, and 54 airplanes. Two years later, by the signing of the armistice in November 1918, the air station, with 438 officers and 5538 enlisted men, had trained 1,000 naval aviators. At war's end, seaplanes, dirigibles, and free kite balloons were housed in steel and wooden hangars stretching a mile down the air station beach.

In the years following World War I, aviation training slowed down. From the 12-month flight course, an average of 100 pilots were graduating yearly. This was before the day of aviation cadets, and the majority of the students included in the flight training program were Annapolis graduates. A few enlisted men also graduated. Thus, Naval Air Station Pensacola became known as the "Annapolis of the Air."

With the inauguration of 1935 of the cadet training program, activity at Pensacola again expanded. When Pensacola's training facilities could no longer accommodate the ever increasing number of cadets accepted by the Navy, two more naval air stations were created - one in Jacksonville, Florida, and the other in Corpus Christi, Texas. In August 1940, a larger auxiliary base, Saufley Field, named for LT R. C. Saufley, Naval Aviator 14, was added to Pensacola's activities. In October 1941, a third field, named after LT T.G. Ellyson, was commissioned.

As the nations of the world moved toward World War II, NAS Pensacola once again became the hub of air training activities. NAS expanded again, training 1,100 cadets a month, 11 times the amount trained annually in the '20s

War in Korea presented problems as the military was caught in the midst of transition from propellers to jets, and the air station revised its courses and training techniques. Nonetheless, NAS produced 6,000 aviators from 1950 to 1953.

Pilot training requirements shifted upward to meet the demands for the Vietnam War which occupied much of the 1960s and 1970s. Pilot production was as high as 2,552 (1968) and as low as 1,413 (1962).

In 1971, NAS was picked as the headquarters site for CNET, a new command which combined direction and control of all Navy education and training. The Naval Air Basic Training Command was absorbed by the Naval Air Training Command, which moved to Corpus Christi.

Today, the Pensacola Naval Complex in Escambia and Santa Rosa counties employs more than 16,000 military and 7,400 civilian personnel.

Luminous paint that contained radium began use in the early 1900's and continued through the 1950's. The paint was applied to various aircraft dials and indicators so they could be visible at night time (Ensafe, 1996).

2.1.2 Site 12

Site 12, knows as the Scrap Bins, is the Defense Reutilization and Marketing Office Recyclable Materials center. It is a storage yard for scrap materials including metals of all types, aircraft, scrap tires, used furniture, and a large amount of electronics. The Final Remedial Investigation Report, NAS Pensacola, OU-2, states that in addition to the radium contamination, soil exceedances mainly included primary/secondary metals, polychlorinated-biphenyls (PCBs) and semi-volatile organic carbons (SVOCs) (EnSafe, 1997).

2.1.3 Site 27

Records indicate that Building 709 was demolished in 1976 (NEESA, 1983). The site is approximately 150 feet west of Building 780 and bounded by Farrar and Murray Roads on the south and west, respectively. An adjacent parking lot north of the building foundation is asphalt-paved, and a gravel and shell parking lot is northeast of the foundation. All roads within the site are paved with either concrete or asphalt (EnSafe, 1997).

Site 27, the Radium Dial Shop Sewer, extends through the remaining concrete foundation of Building 709, which is currently a parking lot. The building foundation is 2 to 4 feet above the surrounding area (EnSafe, 1996), (EnSafe, 1997).

Beyond the building foundation, the sewer easement is unpaved. Originally, the site consisted of a small radium dial shop in former Building 709 with a connection to the sanitary sewer. However, the results of analysis of Remedial Investigation (RI) soil samples collected in the vicinity of the Building 709 foundation expanded the site area to approximately 6 acres (EnSafe, 1997).

Building 709, constructed in 1941, was used for several operations including carburetor repair, propeller repair, painting and maintenance, various instrument shops (including a radium paint room), and a plating shop. In 1949, a small shop in Building 709 was used to rework luminous instrument dials. Worn and damaged instruments were returned to this shop to be stripped and repainted (EnSafe, 1997).

From 1941 to 1965, the stripping procedure required soaking the instruments in benzene, scraping them in a benzene or water bath, or dry scraping and painting them with radium paint under a ventilation hood. After 1965, the procedure switched to scanning the instruments for radium and then stripping them with paint stripper and a lye-nitric acid solution. Contaminated instrument cases were soaked in another acid solution called "Turco" and then scrubbed with a wire brush (NEESA, 1983).

Building 709 also housed a large plating operation from 1941 to approximately 1970. The operation involved the use of 50 solution tanks ranging from 50 to 3,865 gallons in capacity. (E&E, 1992).

A routine disposal operation in former Building 709 involved washing spent cleaning solutions and luminous paint down the drains into the sanitary sewer. The disposed wastes from this location included cleaning solutions containing benzene, white pigments, phosphorus, radium, and small amounts of acidic or caustic solutions. Plating wastes from former Building 709 and shops in Buildings 604 and 649/755 were periodically dumped through drains into the sanitary sewer. Most of the building drains connected to a single line draining into the sanitary sewer line. From 1941 to 1948, all wastes from former Building 709 were discharged directly into Pensacola Bay (NEESA, 1983).

From 1941 to 1962, concentrated cyanide wastes from Building 709 were periodically dumped into the sanitary sewer. After 1962, the cyanide was drummed and disposed 15 miles offshore in the Gulf of Mexico, although small quantities of cyanide continued to be discharged into the sewer. Plating operations ceased in Building 709 in 1970 or 1973. Today, Building 709 has been removed, and the old building foundation is used as a parking lot (NEESA, 1983).

In March of 1976, decontamination of a radium paint room that was located on a mezzanine in Building 709 was performed under the direction of RASO. A sink and associated piping were removed and packaged into DOT approved shipping containers. Flooring and wall materials from the mezzanine room were also removed. The piping that led to the ground floor of Building 709 was removed to 18" below the concrete floor. The drain line was broken off at that point and the hole in the concrete floor was filled with concrete. The dose rate from the drain line before the hole was filled with concrete was reading 1.2 millirem/hr on contact. The disposition of the nine containers containing waste (105.6 ft^3) from the decontamination operation was performed by the Naval Air Rework Facility, Pensacola, FL (RASO, 1976).

A July 1996 Technical Memorandum provides details of a Radiological Investigation the Navy had performed of this site (EnSafe, 1997, Appendix D). The summary of this report states that soil contamination is limited to a 30 by 50 foot area where previous work lead to spilled or dumped radium paint. The contamination is only in the top foot of soil. The OU2 report also identifies a small area in Site 27, apparently a spill south of former Building 709, adjacent to an old stairway (EnSafe, 1997).

2.2 Previous Scoping Survey Activities

From 29 April, 2009 to 30 April, 2009, and then again from 25 August, 2009 to 4 September, 2009 Aleut World Solutions, LLC (AWS) was contracted by the U.S. Army Joint Munitions Command (JMC) to perform radiological scoping surveys and sampling of Sites 12, 25, and 27 located at the Naval Air Station (NAS) Pensacola in Pensacola, Florida.

2.2.1 Site 12 Scoping Surveys (Concrete Surfaces)

Gamma scan surveys were performed with Ludlum Model-2350-1 Data Loggers attached to a Ludlum Model 44-10 2” by 2” NaI Detectors of concrete surfaces inside of the fenced in area (mostly north of Building 3821) at Site 12 and to west of the western perimeter fence. The results ranged from between 3,500 gross cpm to 4,500 cpm both inside and outside of the fenced in area.

Soil samples 0-6” in depth were collected from selected areas under the concrete surfaces from areas east and west of the current western fence line. The samples were sent to an off-site laboratory for gamma spectroscopy analysis (HASL-300 Method EML GA-01-R MOD). The results of the samples are presented in Table 1 below. A map showing the sample locations is presented in Figure 3 below. One sample result (1.61 pCi/g) was at the Derived Concentration Guideline Limit (DCGL) for Ra-226, the rest were below the DCGL.

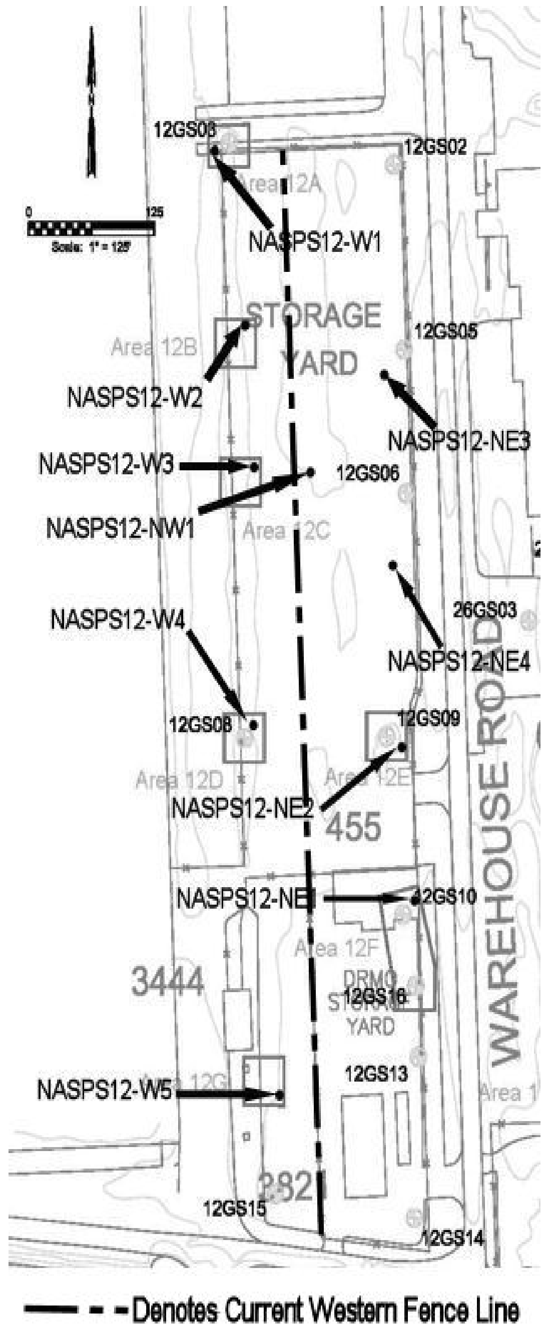
The off-site laboratory’s information is as follows:

Test America Inc.
13715 Ridge Trail North
Earth City, MO 63045
314 298-8566
DOD ELAP Cert # ADE-1430

Table 1 Sample Summary Table

Sample ID#	Date Sampled	Sample Matrix	Location/Description	Bi-214 Results in pCi/g	Bi-214 Detection Limit in pCi/g	Cs-137 Results in pCi/g	Cs-137 Detection Limit in pCi/g	Pb-212 Results in pCi/g	Pb-212 Detection Limit in pCi/g	Pb-214 Results in pCi/g	Pb-214 Detection Limit in pCi/g	Ra-226 Results in pCi/g	Ra-226 Detection Limit in pCi/g	Eu-152 Results in pCi/g	Eu-152 Detection Limit in pCi/g	Notes
NASPS12-W1	8/18/2009	Soil	West of Site 12 Under Concrete Pad	0.400	0.110	0.005	0.048	0.230	0.076	0.421	0.063	0.400	0.110	0.010	0.120	
NASPS12-W2	8/18/2009	Soil	West of Site 12 Under Concrete Pad	1.610	0.080	0.000	0.160	0.530	0.120	1.700	0.120	1.610	0.080	0.060	0.180	
NASPS12-W3	8/18/2009	Soil	West of Site 12 Under Concrete Pad	0.290	0.093	-0.007	0.062	0.169	0.071	0.233	0.130	0.290	0.093	0.004	0.150	
NASPS12-W4	8/18/2009	Soil	West of Site 12 Under Concrete Pad	0.493	0.060	0.000	0.059	0.144	0.070	0.419	0.060	0.493	0.060	-0.009	0.120	
NASPS12-W5	8/31/2009	Gravel	West of Site 12 Gravel	0.620	0.100	0.000	0.076	0.490	0.110	0.710	0.100	0.620	0.100	-0.031	0.140	
NASPS12-NE1	8/31/2009	Soil	Eastern Side of Site 12 Under Concrete Pad	0.170	0.086	0.002	0.046	0.137	0.066	0.317	0.051	0.170	0.086	0.017	0.093	
NASPS12-NE2	8/31/2009	Soil	Eastern Side of Site 12 Under Concrete Pad	0.650	0.100	-0.008	0.063	0.356	0.084	0.552	0.100	0.650	0.100	-0.007	0.140	
NASPS12-NE3	8/31/2009	Soil	Eastern Side of Site 12 Under Concrete Pad	0.290	0.130	-0.010	0.071	0.282	0.072	0.376	0.097	0.290	0.130	0.000	0.190	
NASPS12-NE4	8/31/2009	Soil	Eastern Side of Site 12 Under Concrete Pad	0.361	0.082	-0.004	0.055	0.221	0.075	0.415	0.050	0.361	0.082	-0.008	0.120	
NASPS12-NW1	8/31/2009	Soil	Western Side of Site 12 Uncer Concrete Pad	0.400	0.120	0.030	0.047	0.174	0.087	0.470	0.110	0.400	0.120	0.028	0.130	
			Maximum:	**1.610**		**0.030**		**0.530**		**1.700**		**1.610**		**0.060**		
			Average:	**0.528**		**0.001**		**0.273**		**0.561**		**0.528**		**0.006**		
			Standard Deviation:	**0.408**		**0.011**		**0.142**		**0.420**		**0.408**		**0.025**		

Figure 3 Site 12 Below Concrete Surface Sample Map



2.2.2 *Site 12 Scoping Surveys (Asphalt, Gravel, Soil Surfaces)*

Gamma scan surveys were performed with Ludlum Model-2350-1 Data Loggers attached to a Ludlum Model 44-10 2” by 2” NaI Detectors of asphalt, gravel, and soil surfaces inside of the fenced in area (mostly east of Building 3821) at Site 12. The results ranged from between 3,000 gross cpm to 275,000 cpm.

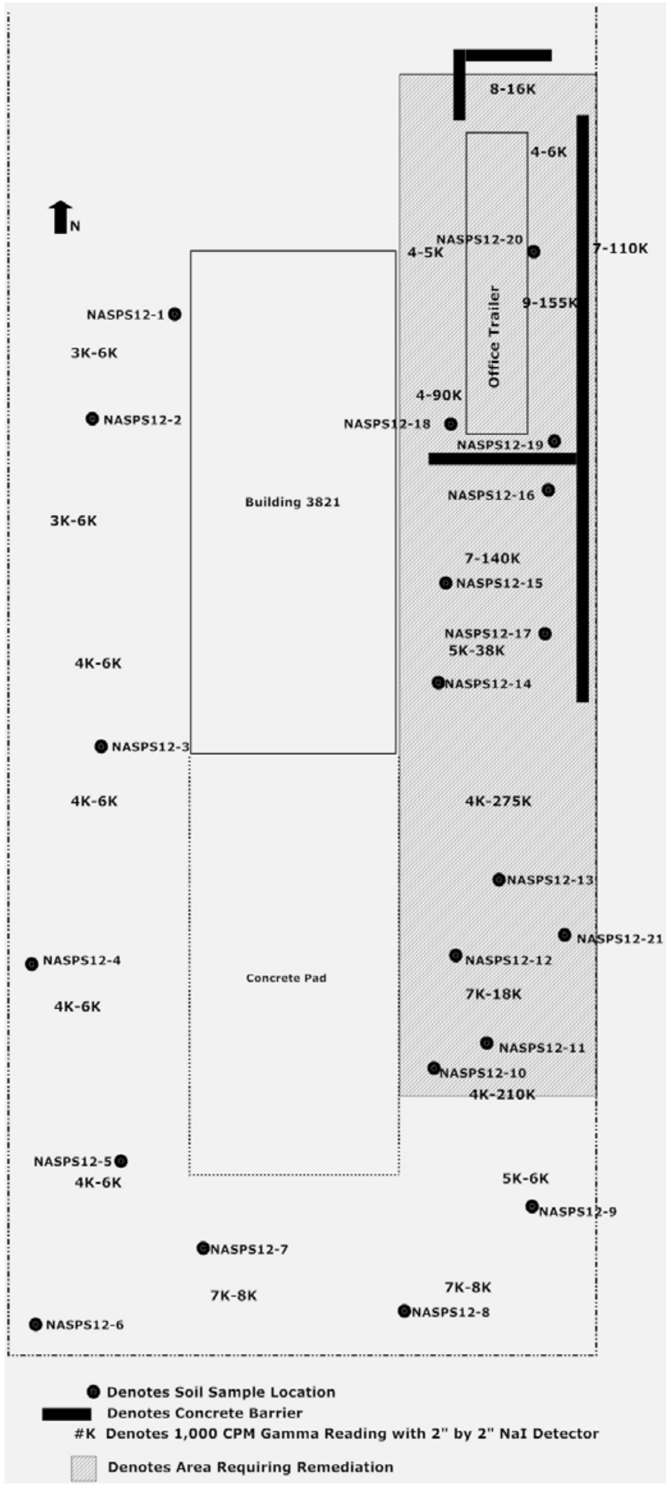
Biased soil samples were collected from the areas that were surveyed. Two of the samples were depth samples collected at 3' bgs and two samples were collected from the bottom of the catch basins located in the southern area. The samples were sent to an offsite laboratory for gamma spectroscopy analysis. The sample results were between 0.22 pCi/g and 947 pCi/g for Ra-226.

The results of the samples are presented in Table 2 below. A map showing the gamma scan survey results and sample locations is presented in Figure 4 below.

Table 2 Sample Summary Table

Sample ID#	Date Sampled	Sample Matrix	Location/Description	Bi-214 Results in pCi/g	Bi-214 Detection Limit in pCi/g	Cs-137 Results in pCi/g	Cs-137 Detection Limit in pCi/g	Pb-212 Results in pCi/g	Pb-212 Detection Limit in pCi/g	Pb-214 Results in pCi/g	Pb-214 Detection Limit in pCi/g	Ra-226 Results in pCi/g	Ra-226 Detection Limit in pCi/g	Eu-152 Results in pCi/g	Eu-152 Detection Limit in pCi/g	Notes
NASPS12-1	8/16/2009	Soil	SW Side of Site 12 West of Building 3821	0.440	0.120	0.076	0.031	0.660	0.100	0.660	0.060	0.440	0.120	-0.009	0.160	
NASPS12-2	8/16/2009	Soil	SW Side of Site 12 West of Building 3821	0.480	0.090	0.014	0.055	0.429	0.070	0.456	0.098	0.480	0.090	0.004	0.110	
NASPS12-3	8/16/2009	Soil	SW Side of Site 12 West of Building 3821	0.400	0.090	0.031	0.044	0.473	0.085	0.509	0.091	0.400	0.090	0.009	0.120	
NASPS12-4	8/16/2009	Soil	SW Side of Site 12 South West of Building 3821	0.440	0.100	0.114	0.022	0.400	0.100	0.518	0.078	0.440	0.100	0.032	0.100	
NASPS12-5	8/16/2009	Soil	SW Side of Site 12 South West of Building 3821	0.420	0.090	0.009	0.057	0.420	0.120	0.349	0.093	0.420	0.090	0.000	0.180	
NASPS12-6	8/16/2009	Soil	SW Side of Site 12 South West of Building 3821	0.221	0.120	0.049	0.048	0.359	0.083	0.415	0.064	0.221	0.120	-0.025	0.120	
NASPS12-7	8/16/2009	Soil	SW Side of Site 12 South of Building 3821	0.260	0.140	0.000	0.064	0.304	0.076	0.322	0.110	0.260	0.140	-0.016	0.130	
NASPS12-8	8/16/2009	Soil	SW Side of Site 12 South East of Building 3821	0.590	0.080	0.365	0.037	0.620	0.090	0.710	0.080	0.590	0.080	0.013	0.140	
NASPS12-9	8/16/2009	Soil	SW Side of Site 12 South East of Building 3821	0.370	0.150	0.060	0.061	0.450	0.140	0.411	0.120	0.370	0.150	-0.006	0.190	
NASPS12-10	9/1/2009	Soil	SE Side of Site 12 South East of Building 3821	5.270	0.170	0.038	0.069	0.310	0.130	5.750	0.150	5.270	0.170	-0.050	0.240	
NASPS12-11	9/1/2009	Soil	SE Side of Site 12 South East of Building 3821	10.700	0.210	-0.025	0.140	0.380	0.160	10.500	0.260	10.700	0.210	0.540	0.320	
NASPS12-12	9/1/2009	Soil	SE Side of Site 12 South East of Building 3821	42.800	0.400	0.217	0.097	0.440	0.300	43.600	0.500	42.800	0.400	2.040	0.650	
NASPS12-13	9/1/2009	Soil	SE Side of Site 12 South East of Building 3821	947.000	2.000	-0.200	2.200	-0.300	4.300	980.000	3.000	947.000	2.000	43.200	3.700	
NASPS12-14	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	94.300	0.600	0.060	0.240	0.330	1.300	96.200	0.700	94.300	0.600	4.700	1.000	
NASPS12-15	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	0.600	0.070	0.121	0.032	0.230	0.084	0.500	0.100	0.600	0.070	0.000	0.180	
NASPS12-16	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	40.400	0.400	0.000	0.360	-0.070	0.400	41.400	0.400	40.400	0.400	1.800	0.670	
NASPS12-17	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	0.860	0.080	0.184	0.019	0.185	0.081	0.780	0.080	0.860	0.080	-0.003	0.140	
NASPS12-18	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	20.200	0.200	0.210	0.099	0.470	0.220	20.800	0.300	20.200	0.200	1.050	0.430	
NASPS12-19	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	15.400	0.300	-0.038	0.150	0.550	0.200	14.900	0.300	15.400	0.300	0.530	0.480	
NASPS12-20	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	0.450	0.120	0.150	0.059	0.238	0.100	0.460	0.110	0.450	0.120	0.006	0.140	
NASPS12-21	9/2/2009	Soil	SE Side of Site 12 South East of Building 3821	0.620	0.140	0.600	0.040	0.460	0.110	0.680	0.120	0.620	0.140	0.007	0.170	
NASPS12-13D	9/2/2009	Soil	SE Side of Site 12 South East of Building 3821	2.550	0.120	0.050	0.064	0.409	0.098	2.590	0.110	2.550	0.120	-0.030	0.180	3' Depth
NASPS12-14D	9/2/2009	Soil	SE Side of Site 12 East of Building 3821	0.770	0.140	0.006	0.060	0.258	0.110	1.000	0.090	0.770	0.140	-0.050	0.180	3' Depth
NASPS12-D1	9/1/2009	Sediment	Site 12 Catch Basin/NE of Building 3821	0.254	0.120	0.005	0.050	0.300	0.110	0.303	0.097	0.254	0.120	0.000	0.160	
NASPS12-D2	9/2/2009	Sediment	Site 12 Catch Basin/West of Building 3821	0.540	0.140	0.037	0.063	0.480	0.140	0.720	0.120	0.540	0.140	-0.030	0.190	
NASPS12WP-1	9/3/2009	Soil	Composite Waste Profile Sample	92.500	0.600	0.001	0.300	0.630	0.470	96.100	0.700	92.500	0.600	4.290	1.000	
			Maximum:	**947.000**		**0.600**		**0.660**		**980.000**		**947.000**		**43.200**		
			Average:	**49.186**		**0.082**		**0.362**		**50.794**		**49.186**		**2.231**		
			Standard Deviation:	**184.999**		**0.149**		**0.205**		**191.440**		**184.999**		**8.453**		

Figure 4 Site 12 Southern Area Sample Location Map



Based on the results of the gamma scan surveys and soil sampling, an area approximately forty one feet by two hundred feet and two foot in depth will have to be remediated in order to meet the soil cleanup standards.

2.2.3 Site 12 Waste Profile Samples

Waste profile soil samples were collected and sent to an offsite laboratory for Toxicity Characteristic Leaching Procedure (TCLP) analysis. Based upon review of the sample analysis, there is no mixed waste anticipated.

The results of these samples have been forwarded to the disposal facility for approval of the waste streams prior to disposal.

2.2.4 Site 25 Scoping Surveys (Outside Areas)

1-minute fixed alpha/beta direct measurements were collected with a Ludlum Model 2360 Data Logger using a Ludlum Model 43-93 large area alpha/beta scintillation detector on the concrete pad areas outside of Building 780 where a radium spill occurred in the past. The survey was biased towards areas (cracks, seams, etc.) where the potential of contamination would be greatest. A total of twenty-five reading weres collected. The results of the survey indicated a few small areas of elevated activity most likely due to naturally occurring radioactive material in the concrete.

Gamma scan surveys were also performed with a Ludlum Model-2350-1 Data Logger using a Ludlum Model 44-10 2” by 2” NaI detector along the entire perimeter (out 2’ feet) of the concrete pad behind Building 780. No detectable activity above background levels were found during this survey.

Based up the results of the scoping surveys it was anticipated that no remediation would be required in this area following the performance of Final Status Surveys (FSS). Table 3 below presents a summary of the survey results.

Survey reports providing the gamma scan data and sample locations from the first scoping survey effort were provided in the Scoping Survey Report, Sites 12, 25, and 27, NAS Pensacola, Pensacola, FL, Rev. 1, June 29, 2009. (AWS, 2009)

Table 3 Building 780 Outside Concrete Pad Survey Summary Table

Survey Area	Date Surveyed	Average Gross Alpha DCGL in $dpm/100cm^2$	Maximum Gross Alpha DCGL in $dpm/100cm^2$	Average Net Gross Alpha Results in $dpm/100cm^2$	Average Net Gross Beta Results in $dpm/100cm^2$	Maximum Net Gross Alpha Results in $dpm/100cm^2$	Maximum Net Gross Beta Results in $dpm/100cm^2$
Building 780 Outside Concrete Pads	4/30/2009	100	300	20	157	158	629

2.2.5 Site 25 Scoping Surveys (Inside Building 780)

2-minute fixed alpha/beta direct measurements were collected at random locations with a Ludlum Model 2360 Data Logger using a Ludlum Model 43-93 large area alpha/beta scintillation detector in the nine rooms inside of Building 780. Surveys were biased to where the potential for contamination would be considered the greatest. The results of the survey indicated a few small areas of elevated activity most likely due to naturally occurring radioactive material in the walls (old red brick) of some of the rooms. A summary of the survey results are presented in Table 4 below.

Table 4 Building 780 Room Survey Summary Table

Area	Date Surveyed	Average Fixed Gross Alpha DCGL in $dpm/100cm^2$	Maximum Net Fixed Alpha Results in $dpm/100cm^2$	Maximum Net Fixed Beta Results in $dpm/100cm^2$	Average Removable Gross Alpha DCGL in $dpm/100cm^2$	Maximum Net Removable Alpha Results in $dpm/100cm^2$	Maximum Net Removable Beta Results in $dpm/100cm^2$
Room #1	8/27/2009	100	24	988	20	4	60
Room #2	8/27/2009	100	19	-117	20	2	60
Room #3	8/27/2009	100	19	324	20	5	108
Room #4	8/27/2009	100	24	164	20	5	70
Room #5	9/1/2009	100	29	756	20	2	82
Room #6	9/1/2009	100	19	465	20	2	48
Room #7	9/1/2009	100	19	344	20	2	61
Room #8	8/27/2009	100	19	812	20	0	65
Room #9	9/1/2009	100	19	247	20	2	73

2.2.6 Site 25Final Status Surveys (Outside Areas)

Final status surveys were performed on the concrete pads outside of Building 780 during the Phase 3 work performed during July and August of 2010.

The outside concrete pads were divided into six Class 1 survey units.

The surveys consisted of 100% alpha-beta scan surveys and a minimum of 16 2-minute fixed alpha/beta direct measurements in each of the survey units. All of the survey results were less than the release criteria presented in Table 10.

Table 5 below presents a summary of the survey results.

Table 5 Site 25 Final Status Survey Summary Table

Area	Date Surveyed	Average Fixed Gross Alpha DCGL in dpm/100cm^2	Maximum Net Fixed Alpha Results in dpm/100cm^2	Maximum Net Fixed Beta Results in dpm/100cm^2	Average Removable Gross Alpha DCGL in dpm/100cm^2	Maximum Net Removable Alpha Results in dpm/100cm^2	Maximum Net Removable Beta Results in dpm/100cm^2
Survey Unit #1	7/27/2010	100	-11	111	1	10	82
Survey Unit #2	7/27/2010	100	-5	62	0	14	93
Survey Unit #3	7/27/2010	100	-2	61	0	10	58
Survey Unit #4	7/28/2010	100	20	242	-2	7	22
Survey Unit #5	8/9/2010	100	58	297	-2	4	13
Survey Unit #6	7/28/2010	100	26	239	1	13	10

2.2.7 Site 27 Gamma Scan Surveys

Gamma scan surveys were performed with a Ludlum Model-2350-1 Data Logger using a Ludlum Model 44-10 2” by 2” NaI detector of the southern outside perimeter grassy area of old Building 709. The results ranged from between 3,500 cpm to 75,000 cpm.

2.2.8 Site 27 Soil Samples

Ten surface soil (0-6" in depth) samples and two asphalt samples were collected from various areas south of the old Building 709 location that were surveyed by gamma scan and sent to an offsite laboratory for gamma spectroscopy analysis. The samples results were between 0.40 pCi/g and 138 pCi/g for Ra-226.

A summary of the results of the sample analysis is presented in Table 6 below.

Table 6 Site 27 Sample Summary Table

Sample ID#	Date Sampled	Sample Matrix	Location/Description	Bi-214 Results in pCi/g	Bi-214 Detection Limit in pCi/g	Cs-137 Results in pCi/g	Cs-137 Detection Limit in pCi/g	Pb-212 Results in pCi/g	Pb-212 Detection Limit in pCi/g	Pb-214 Results in pCi/g	Pb-214 Detection Limit in pCi/g	Ra-226 Results in pCi/g	Ra-226 Detection Limit in pCi/g	Bi-212 Results in pCi/g	Bi-212 Detection Limit in pCi/g	Notes
NASP-1	4/30/2009	Soil	South of Old Building 709	6.080	0.230	0.680	0.090	0.440	0.180	6.620	0.200	6.080	0.230	0.300	0.870	
NASP-2	4/30/2009	Soil	South of Old Building 709	2.570	0.160	0.193	0.077	0.270	0.120	2.700	0.140	2.570	0.160	0.060	0.550	
NASP-3	4/30/2009	Soil	South of Old Building 709	4.030	0.130	0.179	0.077	0.370	0.130	3.480	0.190	4.030	0.130	0.200	0.780	
NASP-4	4/30/2009	Soil	South of Old Building 709	13.800	0.300	0.460	0.160	0.350	0.230	14.400	0.300	13.800	0.300	0.550	0.990	
NASP-5	4/30/2009	Soil	South of Old Building 709	4.920	0.130	0.272	0.069	0.530	0.170	5.060	0.200	4.920	0.130	0.150	0.610	
NASP-6	4/30/2009	Soil	South of Old Building 709	25.600	0.400	0.220	0.240	-0.050	0.440	26.900	0.500	25.600	0.400	2.300	1.600	
NASP-7	4/30/2009	Soil	South of Old Building 709	3.760	0.180	1.200	0.080	0.400	0.150	3.800	0.200	3.760	0.180	0.170	0.650	
NASP-8	4/30/2009	Soil	South of Old Building 709	138.000	0.800	0.001	0.460	-0.200	1.900	141.000	1.000	138.000	0.800	11.100	3.200	
NASPS27-1	8/31/2009	Asphalt	South of Old Building 709/SE Side	1.420	0.170	0.000	0.120	2.980	0.160	1.500	0.180	1.420	0.170	2.610	0.460	
NASPS27-2	8/31/2009	Soil	South of Old Building 709/SE Side	0.400	0.100	0.034	0.053	0.537	0.078	0.453	0.077	0.400	0.100	0.330	0.340	
NASPS27-3	8/31/2009	Soil	East of Old Building 709/South End	0.440	0.110	0.097	0.019	0.202	0.079	0.549	0.081	0.440	0.110	0.080	0.430	
NASPS27-4	8/31/2009	Asphalt	South of Old Building 709/Central	1.250	0.160	-0.001	0.050	2.220	0.160	1.450	0.140	1.250	0.160	1.830	0.500	
			Maximum:	138.000		1.200		2.980		141.000		138.000		11.100		
			Average:	16.856		0.278		0.671		17.326		16.856		1.640		
			Standard Deviation:	38.826		0.355		0.941		39.678		38.826		3.119		

Survey reports providing the gamma scan data and sample locations from the first scoping survey effort were provided in the Scoping Survey Report, Sites 12, 25, and 27, NAS Pensacola, Pensacola, FL, Rev. 1, June 29, 2009. (AWS, 2009)

Maps showing the sample locations and gamma scan survey results from the second scoping survey effort are provided in this plan in Attachment #4.

Based upon the results of the gamma scan surveys and soil sampling, an area approximately thirty five feet by fifty feet in area, and one to two foot in depth will have to be remediated in order to meet cleanup standards. Some limited asphalt and concrete surface removal will also have to be performed.

2.2.9 Site 27 Waste Profile Samples

Waste profile soil samples were collected and sent to an offsite laboratory for TCLP analysis. Based upon review of the sample analysis, there is no mixed waste anticipated.

2.3 Previous Remediation Activities

Previous final status survey activities were performed in Site 25 by AWS in July and August of 2010.

The results of the final status surveys in Site 25 revealed no detectable activity above the release criteria in any of the areas that were surveyed. The survey results for these areas will be provided in the final report that will be completed at the conclusion of all site activities.

Previous remedial actions were performed in Site 12 and Site 27 by AWS in July and August of 2010.

Approximately 33 cubic yards of soil was removed from the Site 27 area and loaded into three 20 cubic yard intermodal roll-off bins and shipped for disposal. The areas were excavated to approximately 2' below grade surface (bgs). The areas excavated were approximately 34 feet by 36 feet and 6 feet by 10 feet in size.

A final status survey was performed in the areas following soil excavation. This survey included a 100% gamma scan walkover survey and the collection of soil samples. All of the soil sample results were below the Derived Concentration Guideline Limit (DCGL) with the exception of samples C-1 and C-3 which reported Ra-226 concentrations of 1.73 pCi/g and 4.15 pCi/g respectively.

These two areas will require further excavation during this phase of the work.

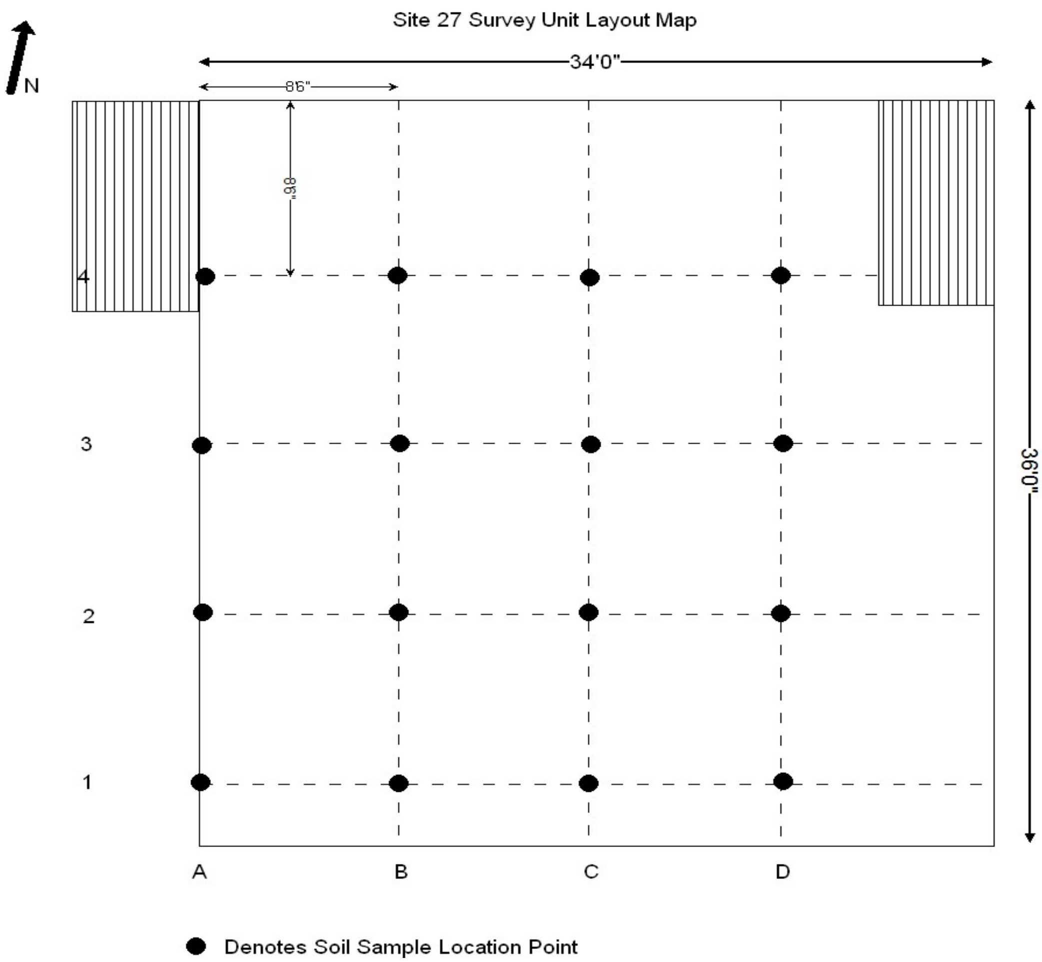
Table 7 below presents a summary of the sample results for Site 27.

Figure 5 presents a map of the sample locations for Site 27.

Table 7 Site 27 Soil Sample Summary Table

Sample ID#	Date Sampled	Sample Matrix	Location/Description	Ra-226 Results in pCi/g	2 σ Uncertainty +/- pCi/g	Ra-226 Detection Limit in pCi/g	Notes
NASPS27-A1	7/23/2010	Soil	Site 27 Survey Unit	0.350	0.090	0.040	
NASPS27A-2	7/23/2010	Soil	Site 27 Survey Unit	0.258	0.094	0.075	
NASPS27A-3	7/23/2010	Soil	Site 27 Survey Unit	0.210	0.090	0.100	
NASPS27-A4	7/23/2010	Soil	Site 27 Survey Unit	0.222	0.079	0.064	
NASPS27-B1	7/23/2010	Soil	Site 27 Survey Unit	0.183	0.080	0.090	
NASPS27-B2	7/23/2010	Soil	Site 27 Survey Unit	0.205	0.076	0.061	
NASPS27-B3	7/23/2010	Soil	Site 27 Survey Unit	0.345	0.089	0.051	
NASPS27-B4	7/23/2010	Soil	Site 27 Survey Unit	0.430	0.100	0.040	
NASPS27-C1	7/23/2010	Soil	Site 27 Survey Unit	1.730	0.220	0.080	
NASPS27-C2	7/23/2010	Soil	Site 27 Survey Unit	0.204	0.058	0.029	
NASPS27-C3	7/23/2010	Soil	Site 27 Survey Unit	4.150	0.380	0.100	
NASPS27-C-4	7/23/2010	Soil	Site 27 Survey Unit	0.580	0.120	0.110	
NASPS27-D1	7/23/2010	Soil	Site 27 Survey Unit	0.290	0.100	0.100	
NASPS27-D2	7/23/2010	Soil	Site 27 Survey Unit	0.530	0.100	0.080	
NASPS27-D3	7/23/2010	Soil	Site 27 Survey Unit	0.790	0.160	0.110	
NASPS27-D4	7/23/2010	Soil	Site 27 Survey Unit	0.168	0.060	0.043	
NASPS27-E1	7/23/2010	Soil	Site 27 Eastern Excavation	0.360	0.120	0.110	
NASPS27-E2	7/23/2010	Soil	Site 27 Eastern Excavation	0.348	0.087	0.086	
NASPS27-W1	7/23/2010	Soil	Site 27 @ Monitoring Well	0.184	0.074	0.085	Monitoring Well Biased Sample
NASPS27-W2	7/23/2010	Soil	Site 27 @ Monitoring Well	0.195	0.087	0.140	Monitoring Well Biased Sample
			Maximum:	**4.150**			
			Average:	**0.631**			
			Standard Deviation:	**0.951**			

Figure 5 Site 27 Soil Sample Location Map



Approximately 612 cubic yards of soil was removed from the Site 12 area and loaded into fifty three 20 cubic yard intermodal roll-off bins and shipped for disposal. The areas were excavated to approximately 2' below grade surface (bgs). The area excavated was approximately 42 feet by 160 feet in size.

During performance of remediation control surveys it was discovered that there were numerous areas of elevated activity above the action level remaining following excavation down to approximately 2' bgs in the area.

Soil samples were collected in these areas at various depths below grade surface in an effort to characterize the remaining areas requiring remediation. There were areas outside of the existing fence (eastern and southern fence) that indicated further remediation would be required.

Table 8 presents a summary of the soil sample results.

Figure 6 and Figure 7 below presents maps that show the locations of the soil samples collected.

Table 8 Site 12 Sample Summary Table

Sample ID#	Date Sampled	Sample Matrix	Depth Below Grade Surface	Location/Description	Ra-226 Results in pCi/g	2 σ Uncertainty +/- pCi/g	Ra-226 Detection Limit in pCi/g	Notes
NASPS12-KR	7/30/2010	Concrete	N/A	Site 12 K Rail	0.910	0.200	0.170	
NASPS12-EP-1	8/19/2010	Soil	1'	Site 12 Eastern Fence Perimeter	0.345	0.095	0.084	
NASPS12-EP-2	8/19/2010	Soil	2'	Site 12 Eastern Fence Perimeter	0.580	0.130	0.100	
NASPS12-EP-3	8/19/2010	Soil	1'	Site 12 Eastern Fence Perimeter	4.480	0.380	0.120	
NASPS12-EP-4	8/19/2010	Soil	2'	Site 12 Eastern Fence Perimeter	0.850	0.130	0.090	
NASPS12-EP-5	8/19/2010	Soil	2'	Site 12 Eastern Fence Perimeter	0.221	0.072	0.074	
NASPS12-EP-6	8/19/2010	Soil	1'	Site 12 Eastern Fence Perimeter	1.240	0.200	0.140	
NASPS12-SP-1	8/19/2010	Soil	2'	Site 12 Southern Fence Perimeter	16.100	1.100	0.200	
NASPS212-E-1	8/20/2010	Soil	3'	Site 12 Excavation Area	7.840	0.620	0.180	
NASPS212-E-2	8/20/2010	Soil	3'	Site 12 Excavation Area	0.145	0.060	0.088	
NASPS212-E-3	8/20/2010	Soil	4'	Site 12 Excavation Area	0.332	0.095	0.090	
NASPS212-E-4	8/20/2010	Soil	4'	Site 12 Excavation Area	1.440	0.220	0.130	
NASPS212-E-5	8/20/2010	Soil	4'	Site 12 Excavation Area	9.230	0.710	0.200	
NASPS212-E-6	8/20/2010	Soil	4'	Site 12 Excavation Area	4.590	0.370	0.180	
NASPS212-E-7	8/20/2010	Soil	4'	Site 12 Excavation Area	21.200	1.400	0.300	
NASPS212-E-8	8/20/2010	Soil	5'	Site 12 Excavation Area	30.400	2.000	0.300	
NASPS212-E-9	8/20/2010	Soil	4'	Site 12 Excavation Area	0.231	0.091	0.110	
NASPS212-E-10	8/20/2010	Soil	3'	Site 12 Excavation Area	0.370	0.081	0.030	
NASPS212-E-11	8/20/2010	Soil	3'	Site 12 Excavation Area	0.520	0.130	0.120	
NASPS212-E-12	8/20/2010	Soil	3'	Site 12 Excavation Area	0.142	0.082	0.130	
NASPS212-E-13	8/20/2010	Soil	3'	Site 12 Excavation Area	9.730	0.700	0.180	
NASPS212-E-14	8/20/2010	Soil	4'	Site 12 Excavation Area	7.990	0.630	0.190	
				Maximum:	**30.400**			
				Average:	**5.584**			
				Standard Deviation:	**8.628**			

Figure 6 Site 12 Excavation Area Elevated Area Sample Map

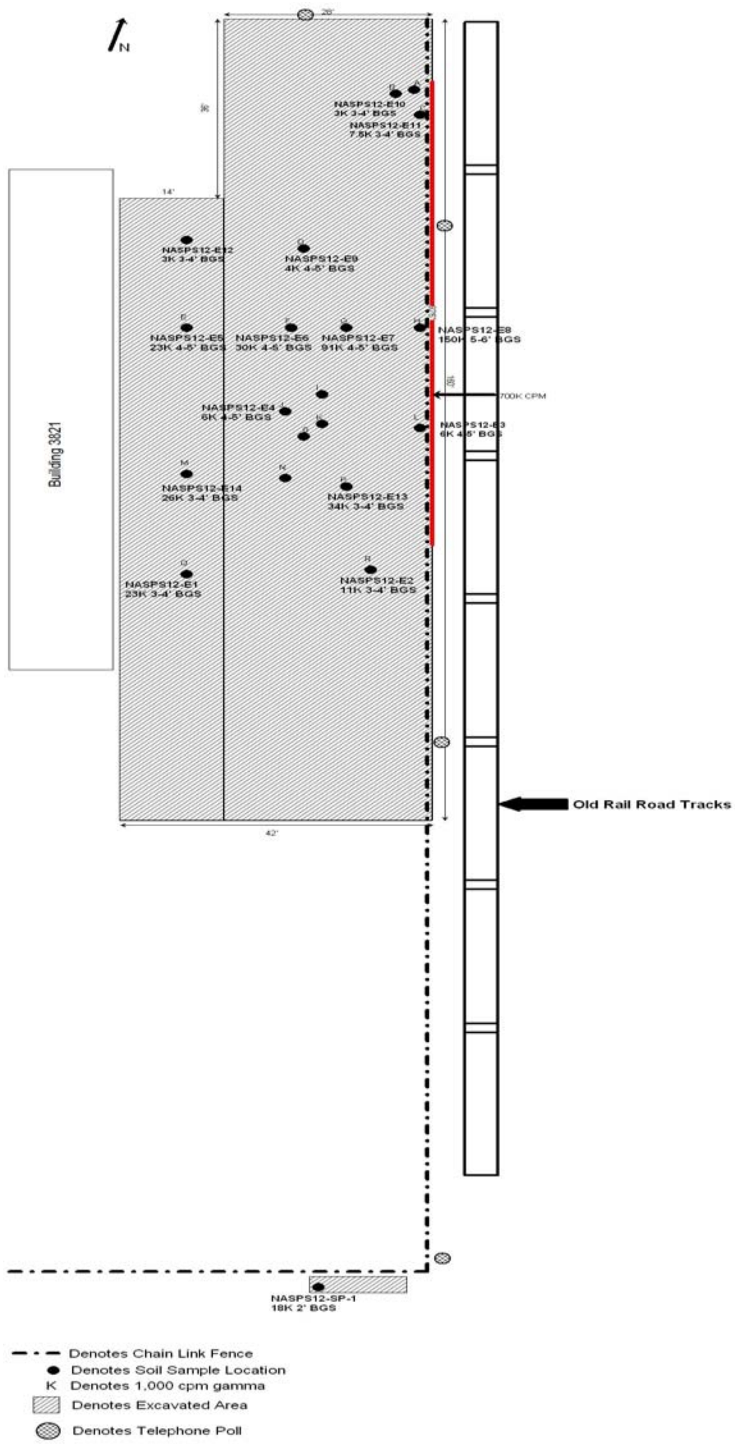
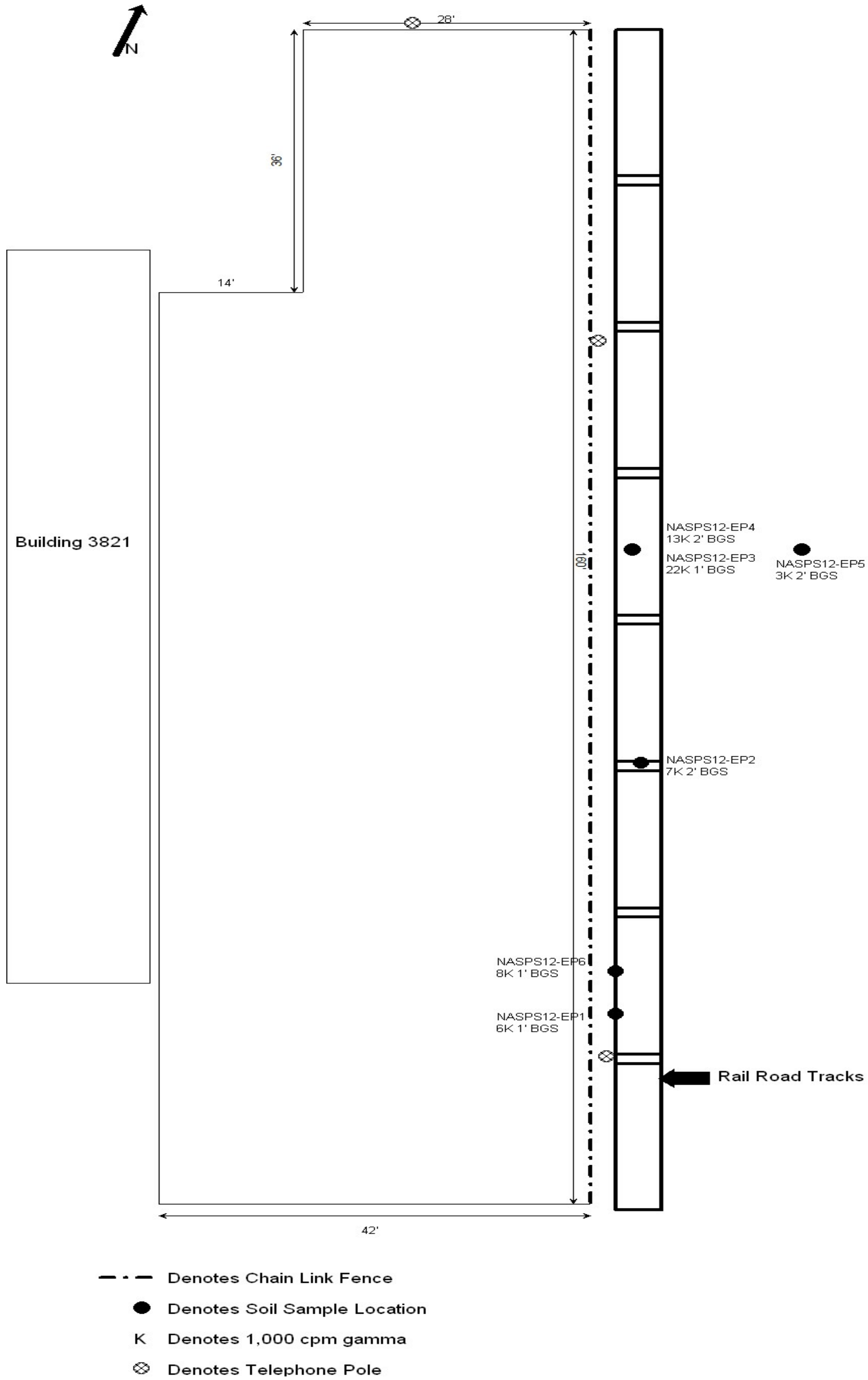


Figure 7 Site 12 Eastern Perimeter Sample Locations



2.4 License Number, Status, and Authorized Activities

All work detailed in this plan will be performed under the AWS Nuclear Regulatory Commission (NRC) Broad Scope Radioactive Materials License 50-29273-01.

A Memorandum of Understanding (MOU) will be completed between the Navy and AWS prior to the start of the remediation and survey activities defining the license responsibilities between the two organizations.

3.0 RADIOLOGICAL CONTROL REQUIREMENTS

3.1 Radiation Work Permit

A Radiation Work Permit (RWP) shall be prepared and will specify the activities to be performed and all radiological safety requirements for the work. All personnel assigned to site work will be required to read and sign the RWP, acknowledging that they understand the requirements of the RWP, prior to beginning work.

The RWP will also be used as an information document for industrial safety. Hazards other than radiological may be included in the RWP so proper protective actions can be taken for all potential hazards. The RWP will clearly specify the need for a briefing on the radiological conditions present in the work environment.

The RWP shall list tasks and specific levels of protection for each worker covered by the RWP. The RWP shall also detail the dosimetry requirements, the protective clothing requirements, and the expected radiation and contamination levels to be encountered during the field survey activity.

3.2 Personnel Monitoring and Dosimetry

Even though the planned work consists of excavation, equipment and area surveys and potential minor decontamination efforts, and the likelihood that personnel will receive any external or internal exposure is considered minimal. Aleut World Solutions administrative policies require the use of external dosimetry on any field project that has the potential for exposure to radioactive material.

The Project Manager (or designee) is responsible for ensuring that all AWS personnel assigned to perform the work (employees, vendors, contractors, and visitors) are appropriately monitored for exposure to ionizing radiation. Each individual working at the site shall wear the dosimetry devices specified in the RWP. Personnel shall be issued a thermoluminescent dosimeter (TLD). The issuance of monitoring devices shall be documented on a Badge Issue Log and furnished to the vendor that processes the TLD's

3.3 Proper Location for Wearing Dosimetry Devices

Unless otherwise directed by the PM (or designee), personnel monitoring dosimetry shall be worn on the front of the body between the neck and the waist. When circumstances are such that other parts of the body could potentially receive a significantly greater dose, the PM may instruct the individual to wear the dosimetry in a more representative location, or may specify additional dosimetric devices. Due to the anticipated low exposure rates at the sites, it is not anticipated at this time that perimeter environmental TLD's will be required.

3.4 Official Exposure Determination and Project Dose Estimate

AWS will be responsible for distributing and collecting the dosimetric devices. The official and permanent record of accumulated external dose received by individuals is obtained from the processing of the personnel monitoring devices (TLDs) by an approved vendor. Once the processing of the personnel monitoring devices has been completed, personnel will be sent a hard copy record (NRC Form 5) of their exposure.

Due to the low exposure rates in the work areas, total crew Total Effective Dose Equivalent (TEDE) is expected to be < 5 mrem.

The NRC annual exposure limits for occupational exposure to radiation as found in 10 CFR Subpart C, Part 20.1201 are as follows:

- 5 Rem TEDE
- 50 Rem; Sum of Deep Dose Equivalent (DDE) and the Committed Dose Equivalent (CDE) to any individual organ or tissue other than the lens of the eye.
- 15 Rem; Lens Dose Equivalent (LDE) to the lens of the eye.
- 50 Rem; Shallow Dose Equivalent (SDE) to the skin of the whole body or to the skin of any extremity.

3.5 Lost or Damaged Dosimetry Devices

Individuals shall immediately notify the PM (or designee) if they lose or damage their dosimeter. A thorough search shall be made for any dosimeter reported lost. Personnel whose exposures are being investigated shall be excluded from work in radiologically controlled areas until the investigation is completed and documented and dosimetry devices reissued. In the event of lost or damaged TLD devices, the PM shall investigate the exposure conditions and assign an external dose for the individual, with concurrence of AWS program management.

4.0 SITE PREPARATION, EQUIPMENT AND PERSONNEL

4.1 Accessibility

Access to the active work areas will be controlled using temporary fencing, barricades, and/or boundary rope/tape. The appropriate postings will be displayed. This will limit access to only those personnel performing work in the areas.

4.2 Office Space and Restroom Facilities

Temporary office space and restroom facilities will be utilized during the task.

4.3 Soil Laydown/Bin Storage Area

It is anticipated at this time that areas (southern portion) of the former Building 709 footprint (presently a parking lot area) will be used for bin storage and soil laydown areas. Figure 8 presents a satellite image of the proposed laydown/storage area.

Figure 8 Soil Laydown/Staging Area Map

4.4 Soil Laydown/Bin Storage Area Pre Job Surveys

The area will undergo a 50% gamma scan survey following completion of work to identify areas of elevated activity. If any areas exceed the investigation level (established at 3σ (standard deviations) above the established background levels), further measurements will be taken to confirm the initial result, and as appropriate, to quantify the area of elevated residual radioactivity that may require further action or remediation.

In addition, 16 systematic 2- minute gross alpha-beta direct measurements will be collected in the area. If any areas exceed the investigation level (established at 90% of the DCGL for surface contamination), further measurements will be taken to confirm the initial result, and as appropriate, to quantify the area of elevated residual radioactivity that may require further action or remediation.

4.5 Electrical Power

Portable generators will be used to provide electrical power in the work areas where it is needed.

4.6 Temporary Fencing

Temporary fencing will be used to restrict access to work areas where needed. If permanent fence lines at Site 12 have to be removed to facilitate excavation, temporary fencing will be used to restrict access to these areas. The permanent fence line will be replaced/repaired after excavation and backfill activities have been completed.

4.7 Area Posting and Access Control

In order to minimize unauthorized access to, and/or removal from the site of radioactive material(s), application of appropriate security protective measures will be exercised (i.e., temporary fencing with locked gates, boundary ropes with warning signs). Licensed radioactive sources and devices, as well as non-exempt quantities of radioactive materials in non-permitted sources, must be routinely inventoried and documented as such. Identification of locations where radioactive materials are present will be accomplished with the use of conspicuous postings compliant with Title 10 Code of Federal Regulations (CFR) Part 20.

Only pre-authorized areas will be used to store radioactive materials at NAS Pensacola. These areas will be selected with concurrence of RASO and the appropriate NAS Pensacola Base personnel. Security measures for these areas will be coordinated with the appropriate NAS Pensacola Base Personnel.

Radioactive material handling activities must be performed in a manner to ensure:

- Access to areas is restricted where radioactive materials are known to be present

- Surveys of radioactive materials storage areas are completed at least weekly

4.8 Import Backfill Soil

Efforts were made to use a source of import backfill soils that is currently approved by the Florida Department of Environmental Protection (Florida DEP) for use in the Petroleum Cleanup Program. The Clark Sand Company borrow pit located at Diamond Dairy Road in Pensacola Florida was chosen as the backfill source. Two grab samples were collected from the borrow pit and sent to an off-site laboratory for analysis. The analysis included:

- Volatiles
- Semi-volatiles
- Base/Neutral Compounds
- Acid Extractables
- RCRA Metals
- Pesticides
- Petroleum Range Organics (FL-PRO)
- Radionuclide's (Gamma Spectroscopy, to include Ra-226)

The results of the sample analysis were compared to the Florida DEP Soil Cleanup Target Levels (SCTL's) as defined in the ROD. None of the analysis results exceeded the SCTL's. The results will be reported in the project final report.

The off-site laboratory's information is as follows:

Test America Laboratories, Inc.

13715 Rider Trail North

Earth City, MO 63045

4.9 Training

Prior to the start of work, all site personnel, including subcontractors, will attend a briefing that will discuss radiological conditions and radiological controls that will be implemented at the site.

4.10 Underground Utility Location

At least 48 hours prior to the start of excavation activities, a call must be placed to Sunshine State One Call at (800) 432-4770 to locate and mark underground utilities in the excavation area.

4.11 Excavation Permit

An excavation permit will be completed and submitted to the appropriate NAS Pensacola Base personnel, and to Irby Engineering at least 3 days prior to the start of excavation activities.

4.12 Incoming Bin Surveys/Inspection

Upon arrival at the site, the 20-25 cubic yard intermodal roll-off bins will undergo incoming radiological surveys. The external and internal surfaces of the bin will be surveyed. The surveys will consist of fixed and loose surface contamination surveys for gross alpha-beta activity and exposure rate surveys. The results of the surveys will be compared to the applicable DOT limits set forth in 49 CFR Parts 173.441 and 173.443. If the results of the surveys are above the DOT limits, further actions (decontamination and/or return of the bin to the originating location) will be required.

The bins will also be inspected prior to use, the inspection will include, but not be limited to the following:

4.12.1 Container Outer Surface Condition

Inspect the outer surface of the container (lid included) for conditions that could compromise the integrity of the container (for example, holes, cracks, bulges, deformations, dents, and evidence of severe corrosion).

If present, inspect the lid lifting rings and attachment points for damage and signs of fatigue.

4.12.2 Container Inner Surface Condition

Inspect the inner surface of the container (lid included). Inspect for holes, cracks, bulges, deformations/dents, and evidence of severe corrosion, which could compromise the integrity of the container.

Note: For both outer and inner surface conditions, minor corrosion and paint flaking is acceptable.

4.12.3 Container Closure

Inspect the lid gasket for deformations, cracks, bulges, and other conditions which could compromise the sealing of the container.

Inspect the gasket-seating surface of the container for cleanliness and debris. Remove any foreign debris and clean the seating surface (as necessary) to ensure proper sealing of the lid.

If present, inspect lid closure bolts for damage and/or signs of fatigue.

If present, inspect the Locking Ring/Ring Bolt/Jam Nut (such as 55-gallon drums) for damage and or signs of fatigue.

4.13 Utility Pole Relocation

Utility poles located along the eastern fence line and one in the northern portion of the excavation at Site 12 will need to be temporarily removed/relocated in order to support work activities in Site 12. Del-Jen Inc. will perform this work.

Del-Jen Inc. provides a broad range of public works and civil engineering services for NAS Pensacola.

All Del-Jen Inc. workers and their subcontractors will be provided a radiological awareness briefing prior to the start of work.

4.14 Site 12 Office Trailer Replacement

Following site release and backfill operations, the office trailer will be placed back into the area adjacent to Building 3821. A local contractor, AAA Mobile Home Movers will perform this action.

4.15 Ground Water Monitoring Well Sampling

Ground water monitoring well sampling will be performed by Enviro-Pro-Tech in six ground water monitoring wells.

Enviro-Pro-Tech is an engineering and environmental consulting firm and cleanup contractor which has conducted business in Florida's panhandle since 1989 and has previous experience in ground water monitoring well sampling at NAS Pensacola.

All Enviro-Pro-Tech workers and their subcontractors will be provided a radiological awareness briefing prior to the start of work.

4.16 Personnel

Task personnel will consist of the following:

Project Manager - Responsible for the overall operations and safety of the project team. The Project Manager will also act as the onsite Radiation Safety Officer (RSO) for the project.

Health Physics Technicians - Perform surveys, sampling operations and supervise any decontamination efforts if required.

Equipment Operator - Operate heavy equipment used to support remediation activities.

Decontamination Technicians - Perform decontamination efforts as required and provide general labor support.

Truck Drivers- Operate trucks for the movement of waste containers between the storage/staging area and excavation areas, and also between the storage area and the rail loading facility.

Visionary Solutions, LLC- Visionary Solutions, LLC personnel will be responsible for scheduling logistics of the waste being packaged and transported to the disposal facility. They will provide truck support for bin movement and support functions at the rail loading facility.

All AWS personnel will be trained and experienced at the tasks to be performed.

5.0 SOIL REMOVAL AND EXCAVATION ACTIVITIES

The excavation work at Site 12 and Site 27 will be sequenced to maximize the completion of all work in an area.

Excavation and survey and sampling activities will be completed in Site 27 prior to beginning work in Site 12. Additional soil removal at sampling locations C1 and C3 at Site 27 will be performed. It is estimated that approximately 27 cubic feet of soil will have to be removed from these two areas.

The estimated dimensions of the excavation areas on the southern perimeter of old Building 709 (Site 27) at sample locations C1 and C3 are ~ 4' by ~ 3'. The depth of the excavation is estimated to be 1' below the existing grade surface. The estimated volume requiring remediation is approximately 27 cubic feet.

Following remediation in these two areas, surveys and sampling of these two areas will be completed to show that the additional remediation was successful.

At Site 12, the excavation will concentrate on the areas of elevated activity within the existing excavation before extending the areal extent of the excavation.

The estimated dimensions of excavation areas in the south eastern area of Site 12 are ~ 46' by 200'.

There are some areas outside of the eastern fence line at Site 12 the will require remediation. Temporary fencing will be used in these areas to restrict personnel access.

The depth of the excavation is estimated to be 1' to 2' below grade surface in areas outside of the existing eastern perimeter fence and up to 3' below the existing grade in the area previously excavated to approximately 2' bgs. The estimated volumes of waste are ~ 1 cubic yard from Site 27 and ~ 503 cubic yards from Site 12. Figure 9 presents a map of the excavation area at Site 27, and Figure 10 presents a map of the excavation area at Site 12.

Figure 9 Site 27 Excavation Area

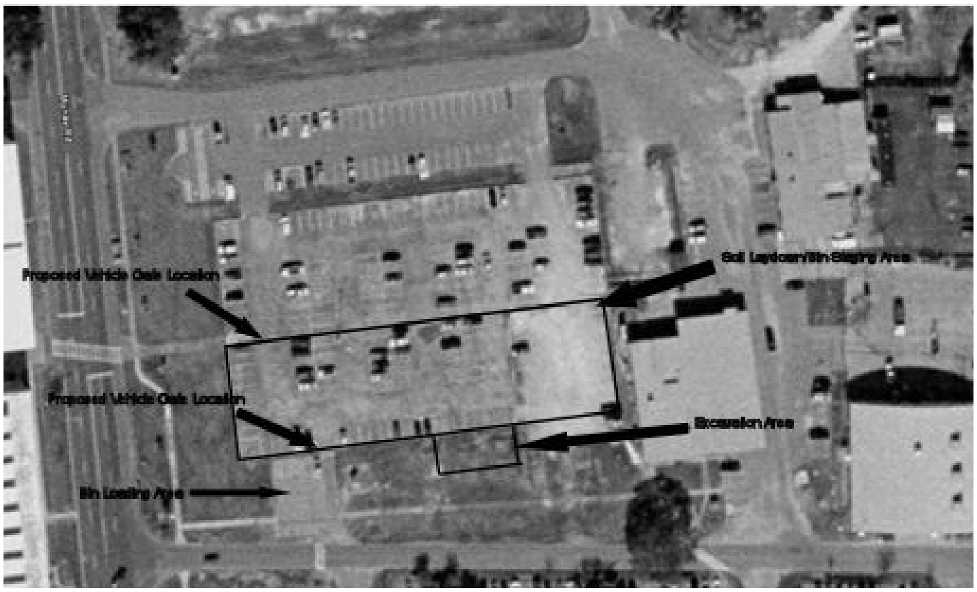


Figure 10 Site 12 Excavation Area

5.1 Storm Water Management

Prior to beginning the excavation, sandbag or straw bale berms will be installed downgradient and upgradient of any excavation where the runoff may lead to open storm drains, as well as to prevent storm water run-on from areas outside of the excavation. Any storm drains located within 50 feet of the excavations and not a part of the removal action will be surrounded with sandbags and the storm drain covered with filter fabric.

5.2 Radiologically Impacted Soil Removal

Soil removal will be accomplished using a backhoe and front end loader combination. For confined areas, a mini excavator will be used. The soil will be excavated with the backhoe/and or mini excavator and placed directly into a front end loader. The front end loader will then place the excavated soils directly into the DOT approved waste container for disposal.

Once full, the container will be placed into the bin storage to await weighing and transport to the rail facility.

5.3 Concrete Slabs, Asphalt, Abandoned Wells

In-place excavated abandoned wells, asphalt, concrete slabs, etc. will be screened manually for alpha and beta/gamma emitters. The surveys will consist of alpha-beta and gamma scans and alpha-beta direct measurements. The results of the surveys will be compared to the DCGL's presented in Table 7 of this plan. Radiologically contaminated material identified during these surveys will be downsized and placed into a DOT approved (20-25 cubic yard intermodal roll-off bin) waste container.

5.4 Dust Suppression

A water truck will be used to lightly wet the soils if dust levels increase during excavation activities.

5.5 Air Sampling

Concentrations of radioactive material in air will be determined, as needed, by sampling the air. Air sampling shall be conducted in accordance with the guidance provided in NRC Regulatory Guide 8.25, "Air Sampling in the Workplace", July 1992 (NRC 1992a). The samples will be collected under known physical conditions (e.g. filter, sample time, flow rate). The flow meters of air samplers shall be calibrated at least annually. Calibration shall also be performed after repair or modification of the flow meter.

Air samples will be collected from general and localized areas when there is potential for generation of airborne radioactive material. These samples will be used to verify that the confinement of radioactive material is effective, and provide warning of elevated concentrations for planning or response actions. In each case, the sampling point will be located in the airflow pathway near the known or suspected release point(s). As necessary, more than one air sample location may be used in order to provide a reasonable estimate of the general concentration of radioactive material in air.

The air sample filters be analyzed onsite for gross alpha-beta activity with a Ludlum Model-2929 Dual Channel Scaler phoswich detector or equivalent.

The AWS Project Manager or his/her designee shall apply professional judgment and experience to identify air sampling appropriate for the specific situation. Such judgment will be based on historical air sampling and characterization results, quantity of contamination of the material being handled, potential for release of contaminants based on physical form and activity, type of confinement or containment, and other factors specific to the activity.

An administrative action level shall be established for breathing zone air samples of 10% of the derived air concentration (DAC); air sample results greater than this administrative action level shall be reported to the AWS Project Manager or his/her designee. An administrative limit shall be established for breathing zone air samples of 12 DAC-hours per week; individual exposure greater than this action level shall require the individual to be restricted from work involving potential exposure to airborne radioactive material unless approved by the AWS RSO or his/her designee.

The 10% DAC value for Ra-226 is 3.0 E-11 μCi/ml which can be found in 10 CFR Part 20, Appendix B, Table 1, Column 3.

5.6 Ground Water Sampling

Ground water sampling will be conducted of six wells in the vicinity of IR Sites and an additional background well. It is currently planned that wells 27GS19, 27GI04, 12GS16, 11G102, 11GS11, and BKG01GI70 will be sampled. Enviro-Pro-Tech will be performing the ground water sampling. The State of Florida sample procedures FS 1000 and FS 2200 will be followed during sampling activities. The purge water from the wells will be contained in 55-gallon drums, sampled, and disposed of appropriately.

Figures 11, 12, and 13 show the locations of the ground water monitoring wells that will be sampled.

Figure 11 Ground Water Monitoring Wells

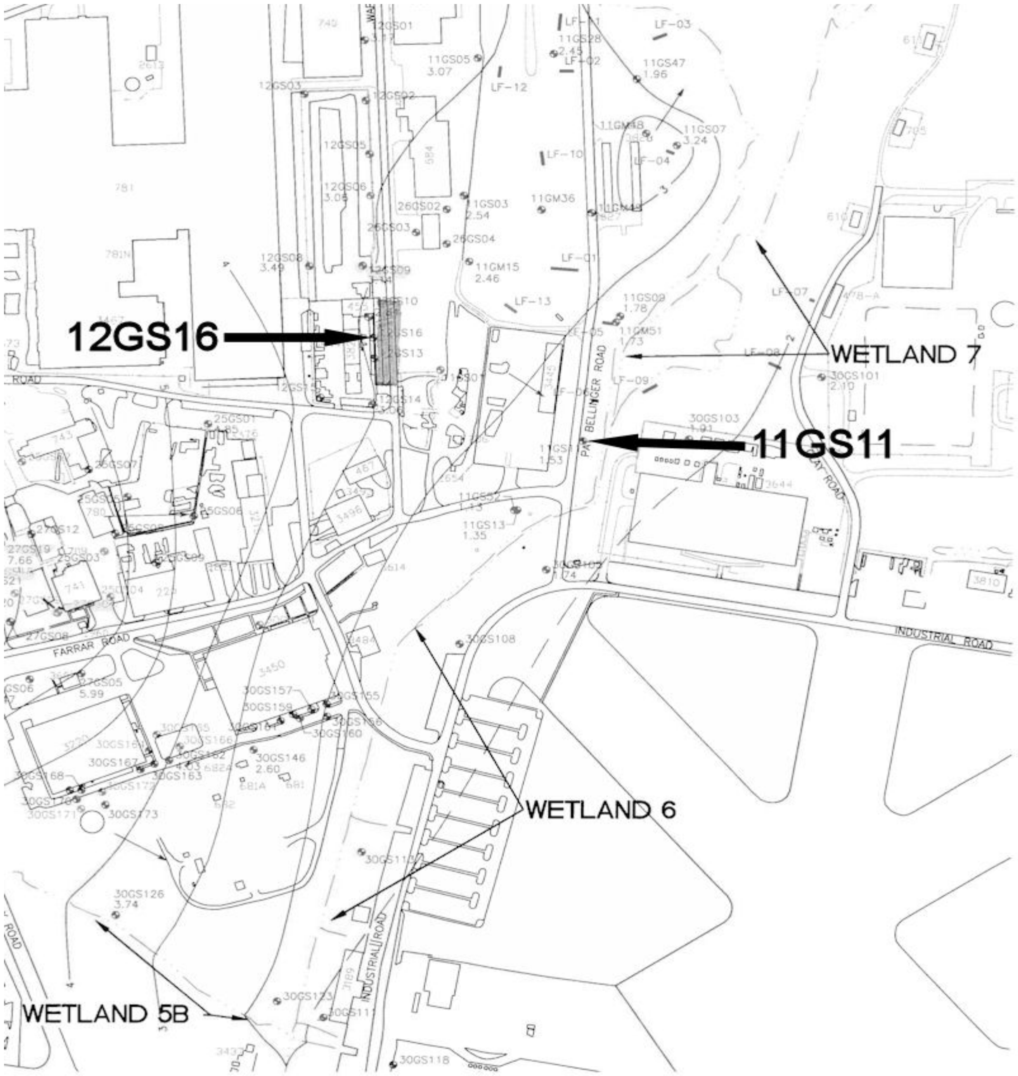


Figure 12 Ground Water Monitoring Wells

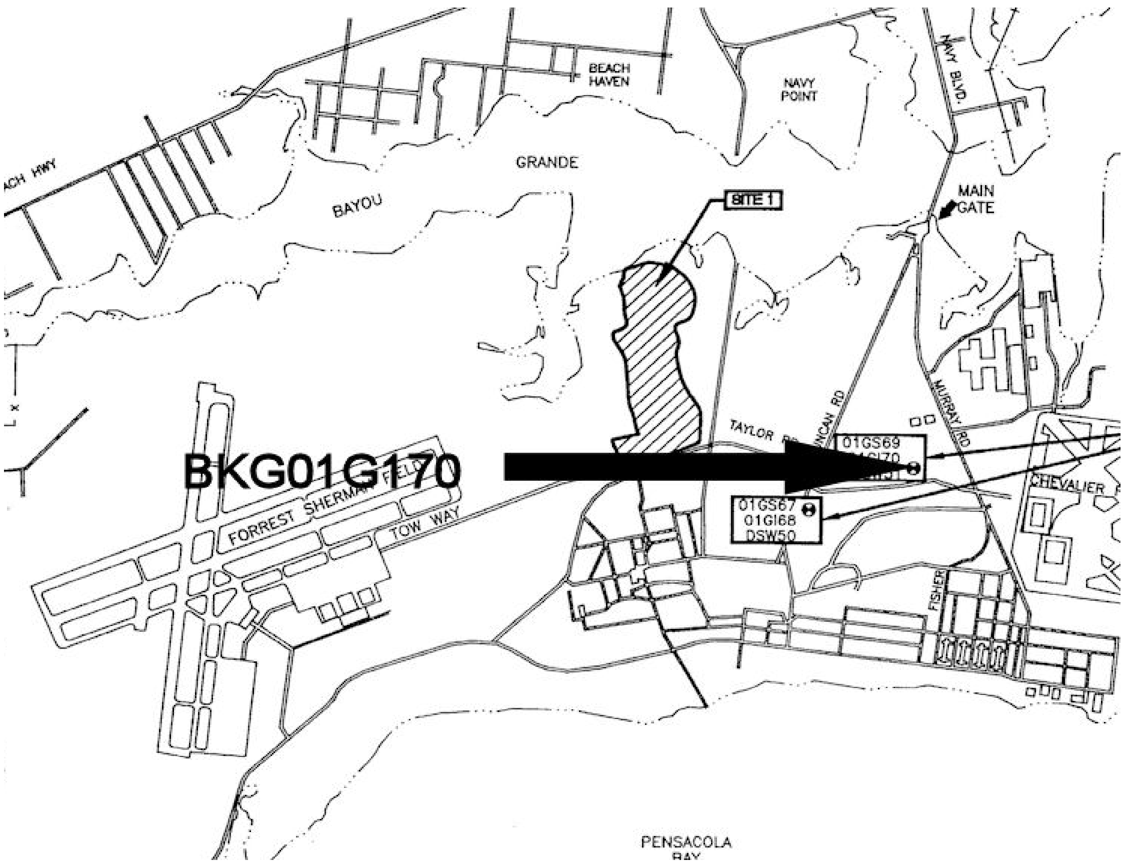
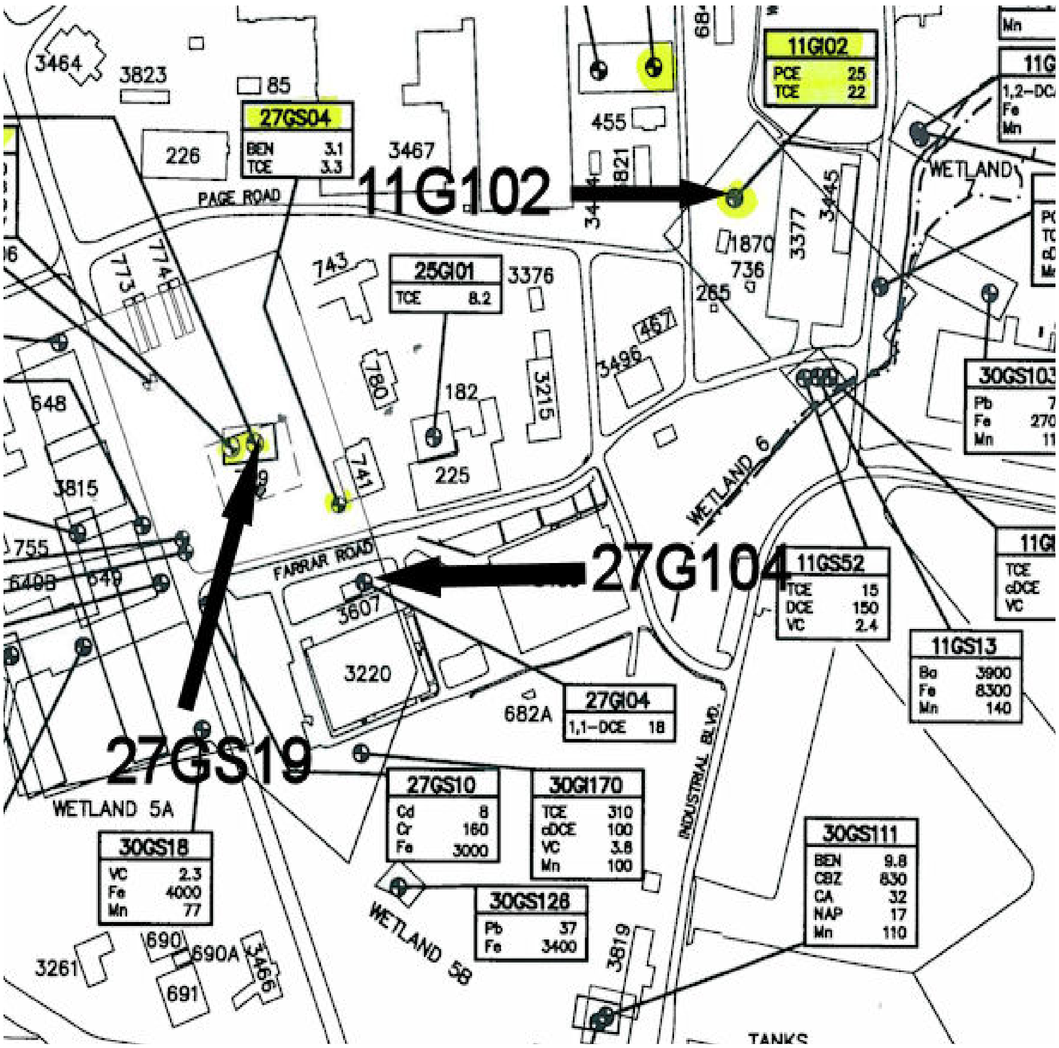


Figure 13 Ground Water Monitoring Wells



6.0 PLANNING PHASE OF RADIOLOGICAL SURVEYS

6.1 Radionuclide of Concern

Based upon historical information from previous investigations and soil sample analysis conducted at Sites 12, 25, and 27 the radionuclide of concern is radium-226 (^{226}Ra). Table 9 lists the radionuclide of concern with the half-life and principle types of radiation (alpha, beta, or gamma).

The radionuclide of concern is the radionuclide at a particular site that could contribute significantly to the dose received by the public.

Table 9 Radionuclide of Concern

Radionuclide	Half-life	Radiations
Radium-226	1,600 years	Alpha (α)/gamma (γ)

6.2 Surface Activity Derived Concentration Guideline Limits (DCGLs) for Radionuclide of Concern for Equipment, Materials, and Tools

The surface activity DCGL's are stated in the "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses, By-product, Source, or Special Nuclear Materials, (NRC 1987)." These DCGL's are applied to incoming and outgoing surveys of equipment used during remediation activities, and surveys of debris and various surfaces (concrete, asphalt, etc.). Table 10 presents the DCGL's.

Table 10 Surface Activity DCGL's for Equipment, Materials, and Tools

Radionuclide	Removable in dpm/100cm^2	Average [2] in dpm/100cm^2	Maximum [3] in dpm/100cm^2	Radiations Emitted
Ra-226	20	100	300	α

1. Measurements of average contaminant should not be over more than 1 m^2
2. The maximum contamination level applies to an area of not more than 100 cm^2

6.3 Derived Concentration Guideline Limit (DCGL) for Radionuclide of Concern for Soil

The DCGL for soil was calculated using RESRAD Version 6.4 Modeling Code developed by Argonne National Laboratory to evaluate doses from exposure to radioactively open land areas.

The calculated DCGL using RESRAD for soil for Ra-226 is 1.61 pCi/g.

The following section provides the details on parameters used for the calculation of the DCGL.

6.4 Dose Modeling Summary

RESRAD is a computer model designed to estimate radiation doses and risks from residual radioactive materials. It is the only code designated by DOE in for the evaluation of radioactively contaminated sites.

NRC has approved the use of RESRAD for dose evaluation by licensees involved in decommissioning, NRC staff evaluation of waste disposal requests, and dose evaluation of sites being reviewed by NRC staff.

Derived Concentration Guideline Levels (DCGL's) are a radionuclide-specific surface or volume residual radioactivity level that is related to a concentration or dose or risk criterion.

The radiation dose is the amount of energy from radiation that is actually absorbed by the body both internally and externally.

The DCGL for soils was calculated using RESRAD Version 6.4 Modeling Code developed by Argonne National Laboratory to evaluate doses from exposure to radioactively open land areas.

DCGLs were determined based on a 25-mrem/yr TEDE target dose. The "Industrial Worker" scenario was used in the calculations. A random activity was selected for Ra-226 and the model was run to determine the resulting peak dose. Using an iterative approach, the input activity was adjusted until the model produced a specific target dose (25 mrem/yr TEDE) result at the peak year. Radionuclide activities (1.61 pCi/g) associated with the target doses were selected as the DCGLs.

RESRAD-Version 6.4 is a validated model that provides conservative dose estimations for outdoor open land areas. The potential characteristics, and predicted future use of the southern perimeter area of Site 12 are well within the predicted capabilities of RESRAD-Version 6.4.

The area default values were replaced with site specific measurements of the eastern area of Site 12. The default parameter values for source area, source/receptor geometry, were replaced with more conservative site specific and/or literature values.

The RESRAD-Version 6.4 model input parameters, including site specific, literature, and default parameters and key parameters used in the "Industrial Worker" scenario are provided in this plan in Attachment 1.

The RESRAD output reports are provided in this plan in Attachment 1.

Table 11 below presents a summary of the pathway selections.

Table 11 Summary of Pathway Selections

Pathway	User Selection
1 – external gamma	Active
2 – inhalation (w/o radon)	Active
3 – plant ingestion	Suppressed
4 – meat ingestion	Suppressed
5 – milk ingestion	Suppressed
6 – aquatic foods	Supressed
7 – drinking water	Supressed
8 – soil ingestion	Active
9 – radon[2]	Active
Find peak pathway doses	Active

Because a validated model and conservative parameter values were used, the DCGL presented in Section 6.3 will likely result in actual doses to the receptors well below the target dose of 25 mrem/yr TEDE.

6.5 Data Quality Objectives

A multi-agency committee representing the Department of Defense (DOD), Department of Energy (DOE), the Environmental Protection Agency (EPA), and the Nuclear Regulatory Commission (NRC) has addressed this need by producing a guidance document known as the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).

Published in December 1997, MARSSIM provides detailed guidance for planning, implementing and evaluating environmental and facility radiological surveys to demonstrate compliance with a dose- or risk-based regulation. MARSSIM focuses on the demonstration of compliance during the final status survey once scoping, characterization and any necessary remedial actions are completed.

MARSSIM provides a single, nationally consistent guide for verifying that radioactively contaminated sites have been cleaned up to standards. Combining this information into one manual has increased efficiency, and has eliminated the confusion that can result from contractors working from multiple manuals.

The surveys of Site 12, Site 25, and Site 27 areas will require sufficient detail to determine if the release criteria are met. The data from the Final Status Surveys that will be performed as defined in MARSSIM will meet the data quality objectives stated below.

The final status survey design process for the excavation bottom and overburden soil begins with development of data quality objectives (DQOs) in accordance with the guidelines outlined in Appendix D of MARSSIM and EPA QA/G4 "Guidance for the Data Quality Objectives Process" (EPA, 2000). The DQOs are then used in conjunction with the radiological conditions at the site to calculate the number and locations of measurement and sampling points to demonstrate compliance with the release criterion as discussed in Section 6.3. Survey techniques and analytical methodologies were selected to generate the required analytical data. Once the data is received from the surveys and laboratory and is validated, it will be evaluated using statistical techniques to test against the hypothesis stated in Section 7.9.2. Sampling, as discussed in this and subsequent sections, refers to the collection of measurement data. “Sampling” includes soil samples for off-site analysis, alpha/beta direct measurements, and swipe samples.

6.5.1 Statement of the Problem

6.5.1.1 Excavation Bottoms/Asphalt-Concrete Surfaces

For the Final Status Surveys of the excavation areas bottom and overburden soils it must be determined if the allowable release limits have been met or if investigation/remediation is warranted. Therefore, the decision to be made can be stated: “Do the Final Status Survey Units meet the allowable soil concentration release limit of 1.61 pCi/g and/or 100 dpm/100cm^2 α”. The null hypothesis (H_o) as required by MARSSIM is stated and tested in the negative form: “The median concentration in the survey unit exceeds the soil concentration release limit.”

Final Status Surveys are surveys, measurements, and sampling, once performed that describe the radiological conditions of a site, following completion of decontamination/remediation activities (if any) in preparation for unrestricted release.

It is anticipated that successful completion of activities described in this Final Status Survey (FSS) Plan will provide sufficient data for the unrestricted release of the areas undergoing survey. Resources available to provide the necessary data include the following:

Activities outlined in this FSS Plan.

Guidance provided in the Multi Agency Radiation Survey & Site Investigation Manual (MARSSIM) for performing Final Status Surveys (FSS).

Process knowledge, inspections, and various radiological survey reports previously conducted in the areas.

Statistical analysis of survey data collected during survey activities outlined in this Survey Plan.

6.5.2 Identification of Decisions

The need to provide data for unrestricted release of the Site 12, and 27 areas and equipment requires the performance of radiological surveys as specified in this FSS Plan.

The primary uses of the data expected to result from completion of this FSS Plan is to provide information and data to support the unrestricted release of excavation bottoms in Sites 12, 27 and areas in Site 25.

6.5.3 Inputs to the Decision

Radiological surveys and sampling required to support the unrestricted release of the areas will include:

Locate and survey background reference area(s) where meaningful background radiation levels can be determined (See Section 7.1 of this plan);

100 % gamma scan survey of the excavated area bottoms and overburden soils (Site 12 and Site 27) with Ludlum Model 2350-1 Data Loggers coupled to Ludlum Model 44-10 2-inch by 2-inch NaI detectors will be performed;

100 % alpha/beta scan surveys of the concrete pad areas outside of Building 780 (Site 25) with Ludlum Model 2360 Data Loggers coupled to Ludlum Model 43-37 large area gas proportional detectors or equivalent will be performed, also concrete and asphalt covered areas in Site 27 will be surveyed in this manner;

Systematic alpha/beta static readings in the survey units (concrete pad areas outside of Building 780);

Systematic soil samples in the survey units (soil, gravel);

Laboratory data validation and statistical analysis of collected data.

6.5.4 Definition of Study Boundaries

The spatial boundary for this survey effort (Site 12 and Site 27) is the entire excavation bottom estimated to be 35’ wide by 50’ long for Site 27 and 41’ wide by 200’ long for Site 12. Each survey unit will be 100 % gamma scan surveyed. Systematic soil samples will also be collected from each survey unit.

The spatial boundary for the concrete surface area in Site 12 is ~ 700’ long by 120’ wide. This area will be 50% gamma scan surveyed. Systematic alpha/beta static readings and swipes will also be collected from each survey unit.

The spatial boundary for the asphalt/concrete surfaces in the soil laydown/bin staging area is ~ 240’ long by 100’ wide. This area will be 50% gamma scan surveyed. Systematic alpha/beta static readings and swipes will also be collected from each survey unit.

The spatial boundary for this survey effort is the entire concrete pad outside of Building 780 (Site 25) which is estimated to be ~ 7,875 in total size (8 separate survey units). Each area will be 100 % alpha/beta scan surveyed. Systematic alpha/beta static readings and swipes will also be collected from each survey unit.

6.5.5 Development of a Decision Rule

6.5.5.1 Surface Activity Release Limits

The surface activity release limits are presented in Table 8.

If during performance of the FSS the values found are greater than the values presented in Table 8 further investigation and decontamination/remediation will be required. If the values found are less than the values presented in Table 8 no further action is required.

6.5.5.2 Soil Concentration Release Limits

The soil concentration limit is 1.61 pCi/g for Ra-226.

6.5.5.3 Investigation Levels

Investigation levels are specific levels of radioactivity used to indicate when additional investigation and/or remediation may be necessary. Investigation levels also serve as a Quality Control (QC) check. For example, in addition to indicating potential contamination, a measurement that exceeds the investigation level may indicate a failing instrument.

When determining an investigation level using a statistical-based parameter (e.g., standard deviation), the following may be considered: survey objectives, underlying radionuclide distributions (e.g., normal, log normal, non-parametric), data population descriptors (e.g., standard deviation, mean, median), and prior survey and historical information.

For alpha surveys, the investigation level will be 90 dpm/100 cm^2 α. This level is set at 90% of the DCGL value.

For gamma surveys, the investigation level will be established at the reference area mean + 3σ, where σ is the standard deviation of the gamma readings in the reference area.

If all areas are less than the investigation levels no further actions will be required.

If an investigation level is exceeded, the measurement will have to be confirmed to ensure that the initial measurement/sample actually exceeded the particular investigation level. This will involve taking further measurements to confirm the initial result, and as appropriate, to quantify the area of elevated residual radioactivity and to determine if further remediation is required.

6.5.6 Limits on Decision Errors

Actions to minimize errors need to be implemented during the data collection phase of the radiological survey. Qualified radiation survey personnel will perform the survey and record the data. Additional actions, such as instrument calibration, daily instrument source checks, and backup surveys with separate instruments provide the primary steps to be taken to avoid errors in the data collection phase of the survey process.

In order to minimize errors, the applicable requirements of AWS Standard Operating Procedures (SOPs) for performing surveys and instrumentation calibration and use will be followed. Copies of the SOPs will be provided upon request.

Data collection and transcribing is the first phase where errors may arise. To avoid data errors for manual surveys, experienced personnel will record and transcribe the data.

The ongoing on-site analyses and evaluation of survey results provides a final check for errors, which if detected, can be corrected.

There are two types of decision errors that can be made when performing the statistical tests described in this plan. The first type of decision error, called a Type I error, occurs when the null hypothesis is rejected when it is actually true. A Type I error is sometimes called a “false positive.” The probability of a Type I error is usually denoted by α. The Type I error rate is often referred to as the significance level or size of the test.

The second type of decision error, called a Type II error, occurs when the null hypothesis is not rejected when it is actually false. A Type II error is sometimes called a “false negative.” The probability of a Type II error is usually denoted by β□. The *power* of a statistical test is defined as the probability of rejecting the null hypotheses when it is false. It is numerically equal to 1-β, where β is the Type II error rate.

This Final Status Survey is designed to limit Type I and Type II errors to 5%. It is important to minimize the chances that survey units exceeding the release limits will be missed (Type I Error) and survey units meeting the release limits will be rejected as too high (Type II Error). The probability of either of these occurring will be set at a maximum of 5%.

6.5.7 Optimizing Data Collection

6.5.7.1 Review Outputs and Existing Data for Consistency

Radioactive source readings will be used to check instruments for consistency prior to use in each daily shift. The instrument will only be used after readings are compared and agree within +/- 20 %.

The Project Manager will review the information each day to verify equipment is operating satisfactorily.

The Project Manager will review the survey data on a daily basis. This will ensure an ongoing independent review for consistency of all survey data collected.

6.5.7.2 Determination of Scan Percentage

100% of the excavated area bottoms and removed overburden soils will be gamma scan surveyed. This is necessary to determine the extent, if any, of residual contamination that might be present.

100% of the concrete pad outside of Building 780 (Site 25) will be alpha/beta scan surveyed. This is necessary to determine the extent, if any, of residual contamination that might be present.

50 % of the soil laydown/bin storage area will be gamma scan surveyed. This is necessary to determine the extent, if any, of residual contamination that might be present.

50 % of the concrete surface area in Site 12 will be gamma scan surveyed. This is necessary to determine the extent, if any, of residual contamination that might be present.

6.5.7.3 Data Collection Decision Alternatives

The data collection design alternatives may change slightly based on conditions found in the field being different than the information furnished based on prior surveys and available information.

In the event that a survey unit classification is revised as a result of detecting unexpected contamination, the Navy will be notified and changes to this survey plan will be required prior to resumption of survey activity.

6.5.7.4 Select Most Resource Effective Survey Design

As indicated above, the survey design specified for use in this survey plan was developed in accordance with best management practices and MARSSIM guidelines and will provide the necessary data for a radiological final status survey. Coupled with the use of experienced personnel and proper instrumentation, this design is the most efficient and resource effective.

6.5.7.5 Document Operational Details and Theoretical Assumptions

Operational details for the radiological survey process have been developed for and are included as part of this survey plan. The theoretical assumptions are based on guidelines contained in MARSSIM (MARSSIM, 2000). Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and action levels are contained in this survey plan.

6.5.8 Sampling Process Design

The sampling process design includes the following elements:

The *types of samples and sampling matrices* for the Final Status Survey of the areas are gamma scans, alpha/beta scans, alpha/beta direct measurements, swipe, and soil samples.

The *sampling frequency* at the areas is set at a minimum of 16 soil samples and/or direct measurements for each of the survey units.

6.6 ALARA Considerations

Based upon previous surveys performed, dose rates, and the anticipated total amount of residual radioactive materials at the NAS Pensacola work areas, direct exposure to radiation to the survey workers will be minimal during remediation and survey activities. Measurements conducted by AWS personnel in May of 2009 show maximum gamma exposure rates including background in the areas is below 5 μR/hr at 1 meter from the ground surfaces. During performance of the excavation, surveys and any potential decontamination activities, the workers exposures are not anticipated to exceed 10 millirem TEDE.

7.0 IMPLEMENTATION PHASE OF SURVEYS

7.1 Background Reference Radiation Levels

A site background reference area will be chosen that has similar physical, chemical, geological, radiological, and biological characteristics as the survey unit being evaluated. Background reference areas are normally selected from non-impacted areas, but are not limited to natural areas undisturbed by human activities. In some situations, a reference area may be associated with the survey unit being evaluated, but cannot be potentially contaminated by site activities. Generally, reference areas should not be part of the survey unit being evaluated.

The site background count rate levels will be established for the final status surveys by obtaining sixteen, 1-minute static readings (with each instrument to be used), taken at 4" from the surface of soil and concrete surfaces for gamma surveys from areas unlikely to be affected by the residual radioactive materials that could be present at the different survey areas. The average value for these readings will be used as the area background radiation levels.

Also, site background count rate levels will be established for the final status surveys by obtaining sixteen, 2-minute static readings (with each instrument to be used), taken on contact with concrete and asphalt surfaces for gross alpha-beta surveys from areas unlikely to be affected by the residual radioactive materials that could be present at the different survey areas. The average value for these readings will be used as the area background radiation levels.

The readings will be documented on Form AWS QA003 or equivalent electronic spreadsheet.

NOTE: 18 background reference area soil samples were collected during previous phases of radiological scoping survey activities at the site. The average Ra-226 concentration was 0.27 pCi/g.

14 of the background samples were collected by EnSafe, Inc. during the 1996 radiological investigation (EnSafe, 1996). 4 additional samples were collected by AWS, LLC during the first 2009 scoping survey effort (AWS, 2009).

Figures 14 and 15 present maps of the sample locations.

Figure 14 Background Reference Area Sample Map

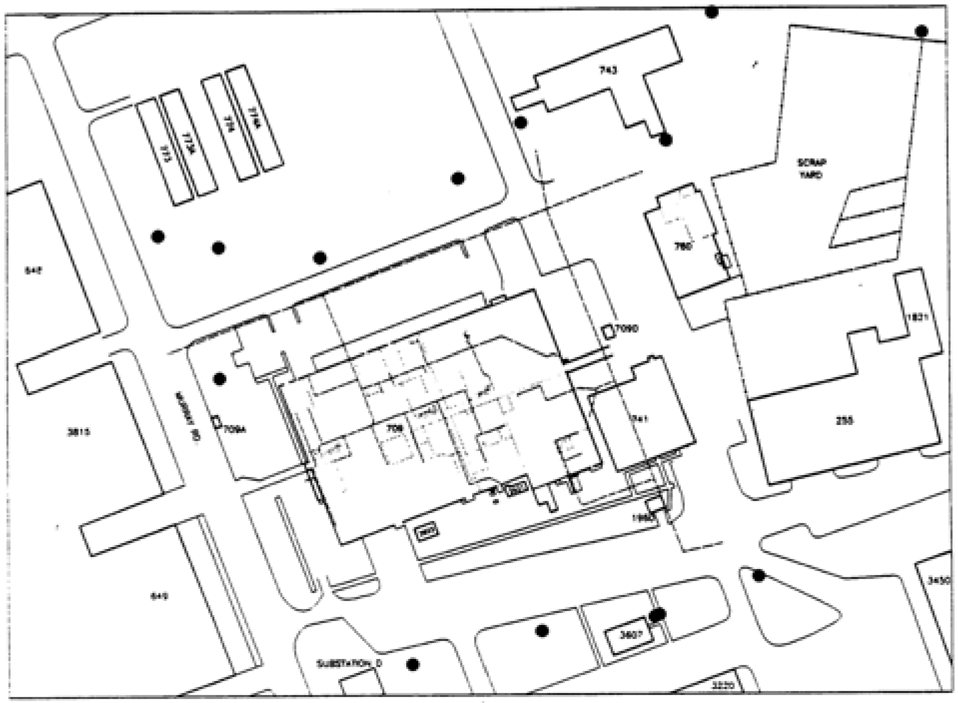


Figure 15 Background Reference Area Sample Map

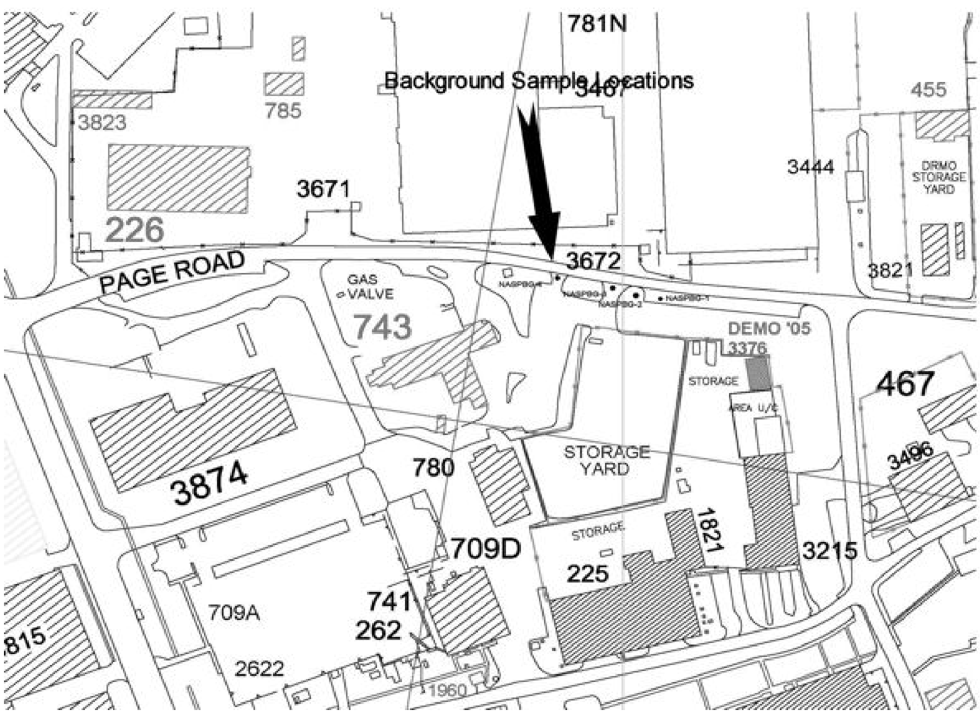
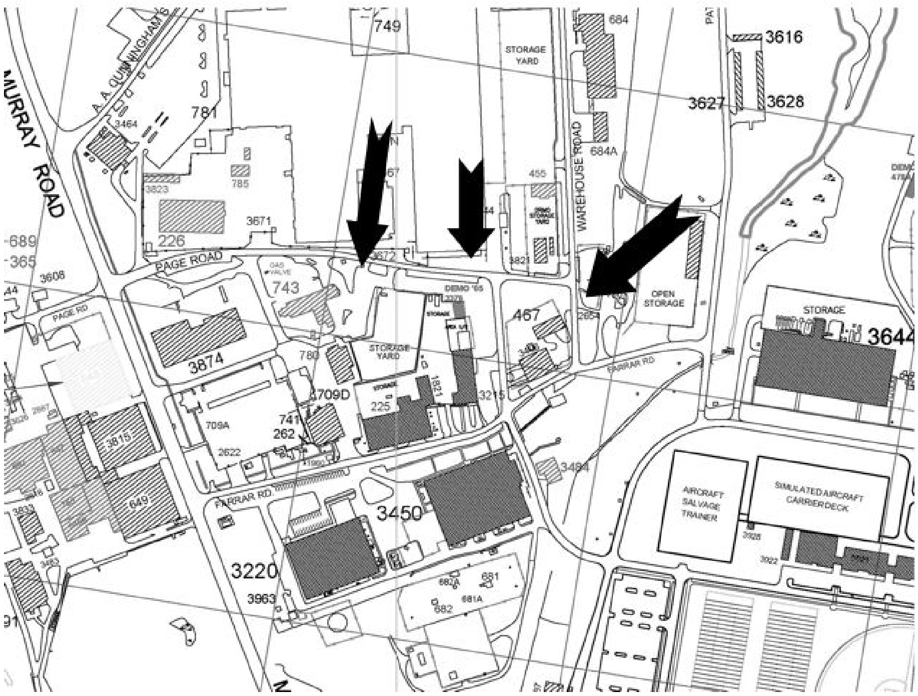


Figure 16 presents a map of the proposed background reference areas.

Figure 16 Background Reference Area Map



7.2 Area Classifications

For the purposes of establishing the sampling and measurement frequency and pattern, the trench bottom and removed overburden soil will be divided into impacted areas with one of three following classifications:

Class 1 Areas: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operational history) or known contamination (based on previous radiation surveys) above the release limits. Examples of Class 1 areas include:

- site areas previously subjected to remedial actions

- locations where leaks or spills are known (or suspected) to have occurred
- radioactive material storage areas
- areas with contaminants in discrete solid pieces of material or high specific activity

*Class 2 Area*s: Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination but are not expected to exceed the DCGL's provided in Sections 6.3 and 6.4. To justify changing the classification from Class 1 to Class 2, there should be measurement data that provides a high degree of confidence that no individual measurement would exceed the release limits. Other justifications for reclassifying an area, as Class 2 may be appropriate, based on site-specific considerations. Examples of areas that might be classified as Class 2 include:

- locations where radioactive materials were present in an unsealed form
- areas downwind from the main areas of concern (AOC)
- areas handling radioactive materials
- areas on the perimeter of former contamination control areas

*Class 3 Area*s: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the release limits, based on site operating history and previous radiation surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

Based upon process knowledge, and operational history, Site 12, Site 25, and Site 27 will be classified as *Class 1* areas. The asphalt/concrete surface areas in the soil laydown/bin storage area will be classified as a *Class 2* area. The concrete surface area in Site 12 will be classified as a *Class 2* area.

7.3 Survey Units

Table 12 below presents the classifications and number of survey units of the areas where radiological surveys and sampling are to be performed during this effort.

Table 12 Field Survey Unit Summary Table

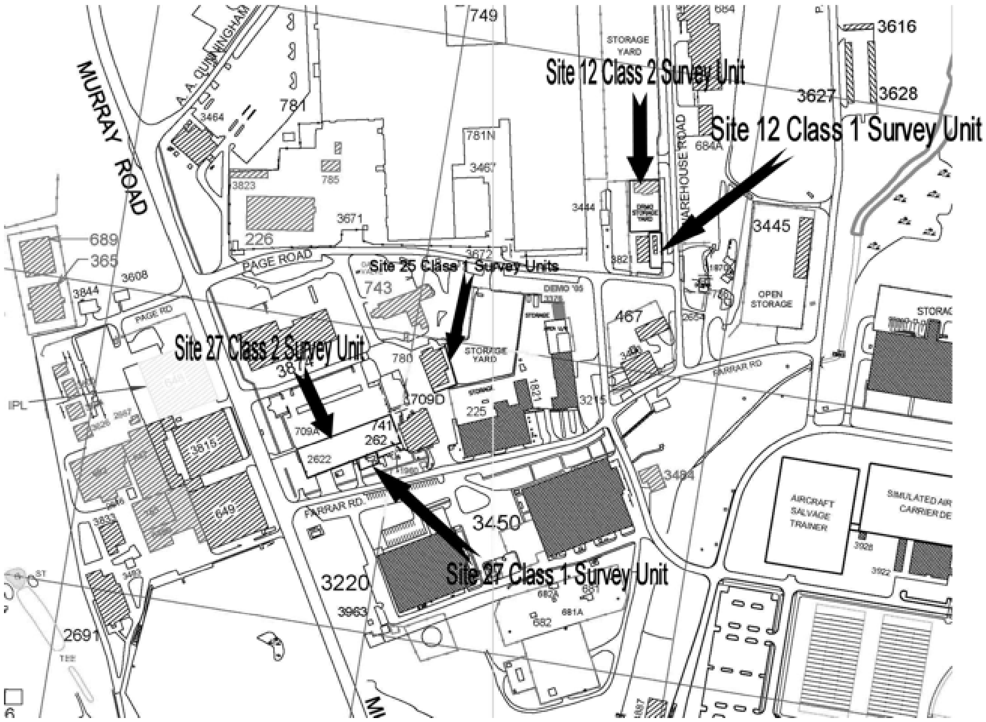
Area/Location	MARSSIM Classification	Total Surface Area (Square meters/Square feet)	Radionuclide(s) of Concern	Number of Survey Units
Site 12 Area East of Building 3821 (Soil, Excavation Bottom)	Class 1	~ 873/9,400	Ra-226	1
Site 27 (Soil, Excavation Bottom)	Class 1	~ 162.5/1,750	Ra-226	1
Site 27 Laydown Area (Concrete/Asphalt)	Class 2	~2,430 /26,160	Ra-226	1

Survey units are limited in size based on classification, exposure pathway modeling assumptions, and site-specific conditions. MARSSIM (Rev. 1, August 2000) recommends areas for survey units according to the following:

Classification	Suggested Area
Class 1 Open Land Areas	up to 2,000 m^2/21,527 ft^2 land area
Class 2 Open Land Areas	2,000 m^2/21,527 ft^2 to 10,000 m^2/107,639 ft^2
Class 3 Open Land Areas	no limit

Figure 17 below presents a map showing the approximate locations of the Class 1 and Class 2 survey units.

Figure 17 Survey Unit Location Map



7.4 Reference Grids

A reference coordinate system will be laid out for each survey unit to obtain survey data and sample location points. A square grid system will be used for the Final Status Surveys in the excavation bottoms, overburden soil, and concrete/asphalt surface survey units. The length, L, of a side of the square grid is determined by the total number of samples or measurements to be taken. The length of the square will determine the distance between direct measurements (MARSSIM, 2000). The length or spacing of the grids will be calculated for the survey unit using the following equation:

Where,

$$L = \sqrt{\frac{A}{N}}$$

L = length of squares grids (ft);

A = surface area of the survey unit (ft^2); and

N = statistically calculated number of samples.

The length of the measurement/sampling intervals for each of the survey units is presented in this plan in Table 13 below.

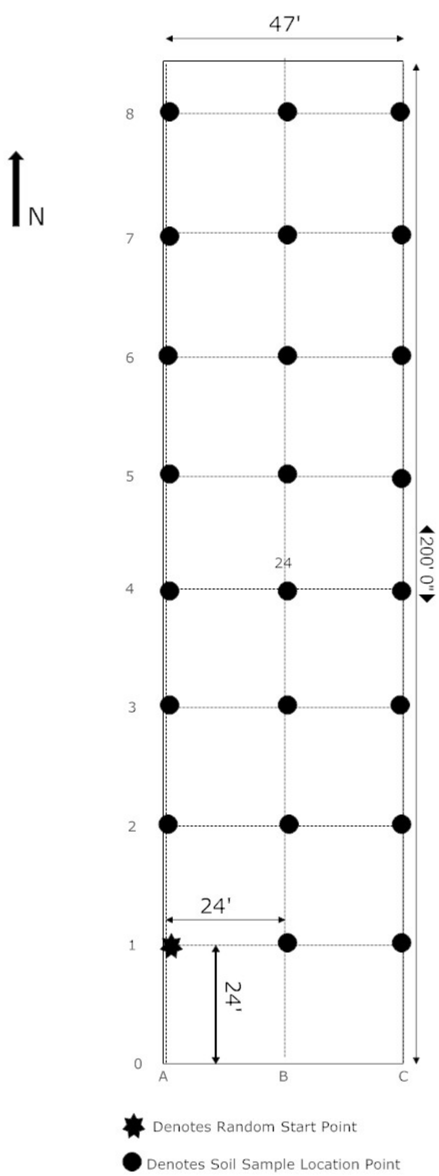
Table 13 Survey Unit Data Table

Survey Unit	Survey Unit Size in m^2/ft^2	MARSSIM Class	Number of Soil Samples/Direct Measurements	Length of Grid Pattern in Meters/Feet [1]
Site 12 Excavation Bottom	~ 873/9,400	1	24/N/A	7.2/24
Site 27 Excavation Bottom	~ 162.5/1,750	1	16/N/A	3.2/10.5
Site 27 Laydown Area (Concrete/Asphalt)	~2,430 /26,160	2	N/A/18	12.1/40

[1] Will be calculated in accordance with Sections 7.3 and 7.4 prior to performance of the survey.

NOTE: Figure 18 presents an illustrative diagram of the survey unit for the excavation bottom in Site 12. Other survey units will laid out in the same manner as described above, but are not illustratively presented in this plan. A minimum of 16 samples will be collected in accordance with Section 7.9.5 of this plan.

Figure 18 Site 12 Excavation Bottom Survey Unit Layout Diagram



7.5 Systematic vs. Biased Sampling

It is important to randomly survey a site, so that each part of the site has an equal chance of being surveyed. This type of survey is called systematic. However, knowledge of the site can identify areas that are more likely to contain contaminants. These should be examined closely. This type of survey is called biased.

Both systematic and biased sampling will be employed in trench bottom and overburden soil survey units. Gamma scan surveys will cover 100% of the soil surfaces. The systematic sampling pattern starting point for the survey units will be randomly placed. However, in addition to these 16 systematic samples, other samples will be collected only where the gamma scan surveys indicates elevated levels of residual contamination, if any are discovered.

7.6 Survey Instrumentation

7.6.1 Instrumentation Selection

Instruments will be selected that are suitable for the physical and environmental conditions at the site. The instruments and measurement methods selected will be able to detect the radionuclide of concern or radiation types of interest, and are, in relation to the survey or analytical technique, capable of measuring levels that are equal to or less than the release limits.

7.6.2 Instrument for the Scan Surveys for Alpha and Beta Surface Activity (Concrete/Asphalt Surfaces, Material, Equipment, and Tools)

Surface scan surveys for alpha and beta radiation will be conducted with Ludlum Model 43-89 large area scintillation probes or equivalent, and/or Ludlum Model 43-37 large area gas proportional probes or equivalent, coupled to Ludlum Model 2360 Data Loggers or equivalent. The probes will have 0.8 mg/cm^2 or 1.2 mg/cm^2 thick Mylar windows. The detector will be moved over the surface being surveyed at a rate of 1 cm per second. The detector will be held within ¼" of the surface being surveyed. Audible indicators will be used during the surveys

7.6.3 Instrument for the Direct Measurements for Alpha and Beta Surface Activity (Concrete/Asphalt Surfaces, Material, Equipment, and Tools)

Direct surface contamination surveys for alpha and beta radiation will be conducted with Ludlum Model 43-89 large area scintillation probes or equivalent, and/or Ludlum Model 43-37 large area gas proportional probes or equivalent coupled to Ludlum Model 2360 Data Loggers or equivalent. The probes will have 0.8 mg/cm^2 or 1.2 mg/cm^2 thick Mylar windows. Direct measurements will be conducted with the detector on contact with the surface for a period of 2 minutes.

7.6.4 Gross Beta-Gamma-Alpha Loose Surface Contamination Surveys

Loose surface contamination surveys of alpha and beta/gamma emitters will be performed using cloth smears.

The swipe survey will be performed by wiping over an area of 100 cm^2 (~ 4" by 4") with a cloth smear, and applying moderate pressure.

The smears will be analyzed with a Ludlum Model-2929 Dual Channel Scaler phoswich detector or equivalent.

7.6.5 Instrument for the Measurement of Gamma Surface Activity

Static and scan surveys for gamma (photon) radiation will be performed using a Ludlum Model 2350-1 data logger. This instrument is equipped with Ludlum Model 44-10 scintillation detector assemblies that featured a 2-inch by 2-inch sodium iodide (NaI) crystal. Capable of detecting gamma photon energies ranging from 60 kilo-electron volts (keV) to 3 mega-electron volts (MeV), the instruments were programmed to respond to the full spectrum of gamma photon energies.

Static gamma measurements require positioning the detector assembly 4 inches (10 centimeters [cm]) above the designated surveillance surface and recording a stationary 60-second integrated count. NaI scintillation detectors are very sensitive to photon gamma radiation and are ideal for locating elevated radiation levels above background when performing gamma scans and static measurements.

Scan measurements will obtained by traversing a path at a maximum speed (scan rate) of approximately 0.5 meters per second (m/s) and slowly sweeping the detector assembly in a serpentine (snakelike, S-shaped) pattern, while maintaining the detector between 2.5 to 4 inches (6 to 10 cm) above the area to be surveyed.

7.7 Detection Sensitivity—Static and Scan Minimum Detectable Concentration (MDC), Gross Alpha-Gross Beta Surveys

NOTE: The calculations in the following sections are for illustrative purposes only. Actual static and scan MDC calculations will be performed at the time of the survey using onsite conditions and the equations below.

7.7.1 Determination of Instrument Efficiency (ε_I) for Alpha and Beta Surface Activity Measurements

The instrument efficiency (ε_I) is determined during calibration and is defined as the ratio between the net count rate (in counts per minute (cpm)) of the instrument and the surface emission rate of the calibration source for a specified geometry. The surface emission rate is the 2π particle fluence that is affected by both the attenuation and backscatter of the radiation emitted from the calibration source. Equation 1 will be used to calculate the instrument efficiency in counts per particle, although efficiency is typically reported as having no units or unitless.

Equation 1

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\Pi}\left(W_A / S_A \right)}$$

Where,

R_{S+B} = the gross count rate of the calibration measurement (cpm)

R_B = the background count rate in cpm

$q_{2\pi}$ = surface emission rate of the calibration source (NIST traceable)

W_A = Active Area of the detector window (cm^2)

S_A = Area of the source (cm^2)

Note: This equation assumes that the dimensions of the calibration source are sufficient to cover the window of the instrument detector. If the dimensions of the calibration source are smaller than the detector's window, set W_A equal to the dimensions of the calibration source, i.e., set the quotient of W_A and S_A equal to 1.

The instrument efficiency is determined during calibration by obtaining static counts with the detector over a calibration source that has a National Institute of Standards and Technology (NIST) traceable surface emission rate. The 2π particle fluence rate is corrected for decay, attenuation and scatter, then; the surface emission rate of the source must be corrected for the area subtended by the probe. Factors that can also affect the instruments efficiency are discussed below:

Calibration Sources: The calibration sources selected emit alpha or beta radiation with energies similar to those expected from the contaminant in the field, i.e., similar to the expected radionuclide(s) of concern.

Source Geometry Factors: The instrument efficiency is determined with a calibration source equal to or greater than the area of the probe.

Source-to-Detector Distance: The detector is calibrated at a source-to-detector distance that is the same as the detector-to-surface distance used in the field.

Window Density Thickness: The detector is calibrated with a probe window density thickness that is the same as the probe window density thickness used in the field.

Detector-Related Factors - Ambient Conditions: If ambient conditions such as the temperature, pressure, and humidity vary significantly, during calibration and during field use, corrections to the detector's response will be considered.

7.7.2 Static MDC for Gross Alpha-Beta Surveys

The static MDC is the level of radioactivity, on a surface, that is practically achievable by the overall measurement process. The conventional equation, Equation 2, is used to calculate instrument MDCs in dpm per 100 cm^2 when the background and sample are counted for the same time intervals.

Equation 2

$$MDC = \frac{3 + 4.65\sqrt{C_B * T_B}}{\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2} T_B}$$

where;

C_B = background count rate (cpm)

T_B = background counting time (min)

ε_i = instrument efficiency (count per particle)

ε_s = contaminated surface efficiency (particle per disintegration)

W_A= area of the detector window (cm^2)

If the background and sample are counted for different time intervals,

Equation 3 is used to calculate the MDC in dpm per 100 cm^2.

Equation 3

$$MDC = \frac{3 + 3.29\sqrt{R_B T_{S+B}\left(1 + \frac{T_{S+B}}{T_B}\right)}}{\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2} T_{S+B}}$$

where;

R_B = background count rate (cpm)

T_B = background counting time (min)

T_{S+B} = sample counting time (min)

ε_ι = the instrument efficiency (count per particle)

ε_s = the contaminated surface efficiency (particle per disintegration)

W_A = the area of the detector window (cm^2)

7.7.3 Surface Efficiency (ε_s) for Surface Activity Measurements

The surface efficiency term in Equation 2 is used to determine the 4π total efficiency for a particular surface and condition. Suitable values are based on the radiation and radiation energy, and are primarily impacted by the backscatter and self-absorption characteristics of the surface on which the contamination exists in the field. Backscatter is most affected by the energy of the radiation and the density of the surface material. Self-absorption characteristics or attenuation are also a function of the radiation's energy and surface condition. Surfaces typically encountered in the field include concrete, wood, dry wall, plaster, carpet, and metal. Surface conditions include both physical effects, such as scabbled concrete, and the effect of surface coatings, i.e., dust, paint, rust, water, and oil.

In the absence of experimentally determined surface efficiencies, ISO-7503-1 and NUREG 1507, provide conservative recommendations for surface efficiencies. ISO-7503-1, recommends a surface efficiency of 0.5 for maximum beta energies exceeding 0.5 MeV, and to use a surface efficiency of 0.25 for beta energies between 0.15 and 0.4 MeV and for alpha emitters (ISO, 1998), (NRC, 1997). NUREG-1507 provides surface efficiencies based on studies performed primarily at ORISE. In general, NUREG-1507 indicates that the ISO rule-of-thumb for surface efficiencies is conservative, particularly for beta-emitting radionuclides with end-point energies between 0.25 MeV and 0.4 MeV.

The surface condition on the areas, equipment, materials, and tools will be asphalt/concrete surfaces that may be slightly covered with dust. The surface efficiency for alpha emitters used in accordance with ISO-7503-1 is 0.25 and for beta emitters is 0.25.

7.7.4 Probe Area Correction Factor for Surface Activity Measurements

In Equation 2, W_A is the size of the "active" area of the detector window. If the area of the detector window (cm^2) does not equal 100 cm^2, it is necessary to convert the detector response to units of dpm per 100 cm^2.

7.7.5 Calculation of Static MDC for Alpha Surveys (582cm^2 probe)

The following example illustrates the calculation of the MDC in dpm/100cm^2 $\beta\gamma$ for the large area gas proportional instrument with a 582 cm^2 probe area that will be used for the direct measurement surveys that will be performed during the Final Status Survey. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 20%

Surface Efficiency Factor: 25%

Background Count Rate: 10 CPM

Sample Count Time: 2 minutes

Probe Area Size: 582 cm^2

The MDC is calculated using equation 2 as follows:

$$MDC = \frac{3 + 4.65\sqrt{10 * 2}}{0.25 * 0.20 * 2 * \frac{582}{100}} = 41 \text{ dpm/100cm}^2 \ a$$

7.7.6 Calculation of Static MDC for Beta Surveys (582cm^2 probe)

The following example illustrates the calculation of the MDC in dpm/100cm^2 $\beta\gamma$ for the large area gas proportional instrument with a 582 cm^2 probe area that will be used for the direct measurement surveys that will be performed during the Final Status Survey. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 20%

Surface Efficiency Factor: 25%

Background Count Rate: 1000 CPM

Sample Count Time: 2 minutes

Probe Area Size: 582 cm^2

The MDC is calculated using equation 2 as follows:

$$MDC = \frac{3 + 4.65\sqrt{1000 * 2}}{0.25 * 0.20 * 2 * \frac{582}{100}} = 362 \text{ dpm/100cm}^2 \ \beta\gamma$$

7.7.7 Calculation of Static MDC for Alpha Surveys (126cm^2 probe)

The following example illustrates the calculation of the MDC in dpm/100cm^2 α for the large area scintillation instrument with a 126 cm^2 probe area that will be used for the direct measurement surveys that will be performed during asphalt/concrete surface, equipment, material, and tool release surveys. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 25%

Surface Efficiency Factor: 25%

Background Count Rate: 2 CPM

Sample Count Time: 2 minutes

Probe Area Size: 126 cm^2

The MDC is calculated using equation 2 as follows:

$$MDC = \frac{3 + 4.65\sqrt{2 * 2}}{0.25 * 0.25 * 2 * \frac{126}{100}} = 78 \text{ dpm/100cm}^2 \ a$$

7.7.8 Calculation of Static MDC for Beta Surveys (126cm² probe)

The following example illustrates the calculation of the MDC in dpm/100cm^2 $\beta\gamma$ for the large area scintillation instrument with a 126 cm^2 probe area that will be used for the direct measurement surveys that will be performed during asphalt/concrete surface, material, equipment, and tool release surveys. The measurement and background counting times are each two minutes:

Where:

Instrument Efficiency: 15%

Surface Efficiency Factor: 25%

Background Count Rate: 200 CPM

Sample Count Time: 2 minutes

Probe Area Size: 126 cm^2

The MDC is calculated using equation 2 as follows:

$$MDC = \frac{3 + 4.65\sqrt{200 * 2}}{0.15 * 0.25 * 200 * \frac{126}{10068}} = 1{,}016 \text{ dpm/100cm}^2 \ \beta\gamma$$

7.7.9 Scanning Minimal Detectable Count Rate, (MDCR)

The minimum detectable number of net source counts in the scan interval, for an ideal observer, can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in *d'*) as shown in Equation 4.

Equation 4

$$MDCR = d'\sqrt{b_i} \times {}^{60}\!/_{i}$$

where,

d' = index of sensitivity (α and β error) – MARSSIM Table 6.5

b_i = number of background counts in scan time interval (count)

i = scan or observation interval (s) (time that a typical source remains under the probe during the scan)

7.7.10 Determination of MDCR and Use of Surveyor Efficiency (Beta, 126 cm² probe)

The minimum detectable number of net source counts in the interval is given by S_i Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance (as reflected in *d'*) as shown in the equation below.

$$S_i = d'\sqrt{b_i}$$

The following example illustrates the calculation of the MDCR in dpm/100cm^2 βγ for the large area scintillation instrument with a 126 cm^2 probe area that will be used for the scan surveys that will be performed during asphalt/concrete surface, material, equipment, and tool release surveys. The background count rate for these detectors is typically 150-200 CPM βγ. For this calculation a background count rate of 200 CPM will be used. It will be assumed that a typical source remains under the probe for 6 seconds during the scan, therefore the average number of background counts in the observation interval is 20 ($b_i = 200 \times (6/60)$). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of d', representing this performance goal, is 3.28.

The minimum detectable number of net source counts, S_i, needed will be estimated by multiplying 4.47 (the square root of 20) by 3.28 (the d' value); so S_i equals 14.7.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60 / i)$$

$$MDCR = 14.7(60 / 6) = 147 cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{147}{\sqrt{0.5}} = 208 cpm$$

7.7.11 Determination of MDCR and Use of Surveyor Efficiency (Alpha, 126 cm² probe)

The minimum detectable number of net source counts in the interval is given by S_i Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance (as reflected in d') as shown in the equation below.

The following example illustrates the calculation of the MDCR in dpm/100cm² α for the large area scintillation instrument with a 126 cm² probe area that will be used for the scan surveys that will be performed during asphalt/concrete surface, material, equipment, and tool release surveys. The background count rate for these detectors is typically 0-2 CPM α. For this calculation a background count rate of 2 CPM will be used. It will be assumed that a typical source remains under the probe for 6 seconds during the scan therefore, the average number of background counts in the observation interval is 0.2 ($b_i = 2 \times (6/60)$). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of d', representing this performance goal, is 3.28.

The minimum detectable number of net source counts, S_i , needed will be estimated by multiplying 0.45 (the square root of 0.2) by 3.28 (the d' value); so S_i equals 1.5.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60 / i)$$

$$MDCR = 1.5(60 / 6) = 15cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and a background count rate of 2 cpm as follows:

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{15}{\sqrt{0.5}} = 21cpm$$

7.7.12 Determination of MDCR and Use of Surveyor Efficiency (Beta, 582 cm^2 probe)

The following example illustrates the calculation of the MDCR in dpm/100cm^2 βγ for the large area gas proportional instrument with a 582 cm^2 probe area that will be used for the scan surveys that will be performed during the Final Status Survey. The background count rate for these detectors is typically 1000-1200 CPM βγ. For this calculation a background count rate of 1000 CPM will be used. It will be assumed that a typical source remains under the probe for 10 seconds during the scan, therefore the average number of background counts in the observation interval is 166.7 ($b_i = 1000 \times (10/60)$). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of d', representing this performance goal, is 3.28.

The minimum detectable number of net source counts, S_i, needed will be estimated by multiplying 12.9 (the square root of 166.7) by 3.28 (the d' value); so S_i equals 42.3.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60/i)$$

$$MDCR = 42.3(60/10) = 254cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{254}{\sqrt{0.5}} = 360cpm$$

7.7.13 Determination of MDCR and Use of Surveyor Efficiency (Alpha, 582 cm^2 probe)

The following example illustrates the calculation of the MDCR in dpm/100cm^2 α for the large area gas proportional instrument with a 582 cm^2 probe area that will be used for the scan surveys that will be performed during the Final Status Survey. The background count rate for these detectors is typically 2-10 CPM α. For this calculation a background count rate of 10 CPM will be used. It will be assumed that a typical source remains under the probe for 10 seconds during the scan therefore, the average number of background counts in the observation interval is 1.7 ($b_i = 10 \times (10/60)$). The required rate of true positives will be 95%, and the false positives will be 5%.

From Table 6.5 of MARSSIM, the value of d', representing this performance goal, is 3.28.

The minimum detectable number of net source counts, S_i , needed will be estimated by multiplying 1.3 (the square root of 1.7) by 3.28 (the d' value); so S_i equals 4.2.

The minimum detectable source count rate (MDCR), in cpm, may be calculated by:

$$MDCR = S_i(60/i)$$

$$MDCR = 4.2(60/10) = 25.2cpm$$

The $MDCR_{Surveyor}$ is calculated assuming a surveyor efficiency (p) of 0.5 and a background count rate of 10 cpm as follows:

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{25.2}{\sqrt{0.5}} = 36cpm$$

7.7.14 Scan MDC

The scan MDC is determined from the minimum detectable count rate (MDCR) by applying conversion factors that account for detector and surface characteristics and surveyor efficiency. As discussed below, the MDCR accounts for the background level, performance criteria (d'), and observation interval. The observation interval during scanning is the actual time that the detector can respond to the contamination source. This interval depends on the scan speed, detector size in the direction of the scan, and area of elevated activity.

The scan MDC for equipment, material, and tool surfaces is calculated using Equation 5.

Equation 5

$$Scan\ MDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2}}$$

Where;

MDCR = discussed in Section 7.7.9

p = surveyor efficiency factor

ε_i = instrument efficiency (count per particle)

ε_s = contaminated surface efficiency (particles per disintegration)

W_A = area of the detector window (cm^2)

7.7.15 Scan MDCs for Asphalt/Concrete Surfaces, Materials, Equipment, and Tools (Beta-Gamma, 126cm² probe)

The scan MDC may be calculated by:

$$ScanMDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{probe\ area\ in\ cm^2}{100cm^2}}$$

Where;

MDCR = minimum detectable count rate

ε_I = instrument efficiency

ε_s = surface efficiency

p = surveyor efficiency

The scan MDC (in dpm/100 cm^2) on the asphalt/concrete surface, material, equipment, and tool surfaces may be determined for a background level of 200 cpm and a 6-second observation interval using a hand-held scintillation detector (126 cm^2 probe area). For the specified level of performance a 95% true positive rate and 5% false positive rate will be required.

d' equals 3.28 (Table 6.5 of MARSSIM) and the MDCR is 147 cpm. Using a surveyor efficiency of 0.5, and assuming instrument and surface efficiencies of 0.15 and 0.25, respectively, the scan MDC is calculated using the equation below:

$$Scan\ MDC = \frac{147}{\sqrt{0.5}\ (0.15)(0.25)(1.26)} = 4391 dpm / 100 cm^2 \beta\gamma$$

Using the above equations found in Chapter 6 of MARSSIM (Rev. 1, August 2000) the detection sensitivity for such surveys for using the above survey parameters and a large area scintillation detector is approximately 4,391 dpm/100cm^2 beta-gamma.

7.7.16 Scan MDCs for Asphalt/Concrete Surfaces, Materials, Equipment, and Tools (Alpha, 126cm² probe)

Scanning for alpha emitters differs significantly from scanning for beta and gamma emitters in that the expected background response of most alpha detectors is very close to zero. The following sections cover scanning for alpha emitters and assumes that the surface being surveyed is similar in nature to the material on which the detector was calibrated. In this respect, the approach is purely theoretical. Surveying surfaces that are dirty, non-planar, or weathered can significantly affect the detection efficiency and therefore bias the expected MDC for the scan. The use of reasonable detection efficiency values instead of optimistic values is highly recommended.

Since the time a contaminated area is under the probe varies and the background count rate of some alpha instruments is less than 1 cpm, it is not reasonable to determine a fixed MDC for scanning. Instead, it is more practical to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates.

For alpha survey instrumentation with backgrounds ranging from <1 to 3 cpm, a single count provides a surveyor sufficient cause to stop and investigate further. Assuming this to be true, the probability of detecting given levels of alpha surface contamination can be calculated by use of Poisson summation statistics.

Given a known scan rate and a surface contamination release limit, the probability of detecting a single count while passing over the contaminated area is

$$P(n \geq 1) = 1 - e^{\frac{-GEd}{60v}}$$

Where

$P(n \geq 1)$	=	probability of observing a single count
G	=	contamination activity (dpm)
E	=	detector efficiency (4π)
d	=	width of detector in direction of scan (cm)
v	=	scan speed (cm/s)

The following example illustrates the calculation of the calculation of the probability for the large area scintillation instrument with a 126 cm^2 probe area that will be used for the scan surveys of asphalt/concrete surfaces, materials, equipment, and tools:

$$.58 = 1 - e^{\frac{-100*0.06*8.75}{60(1.0)}}$$

Where

G	=	100 dpm
E	=	6 %
d	=	8.75 cm
v	=	1.0

Once a count is recorded and the guideline level of contamination is present the surveyor should stop and wait until the probability of getting another count is at least 90%. This time interval can be calculated by:

$$t = \frac{13,800}{CAE}$$

Where

t	=	time period for static count(s)
C	=	contamination guideline (dpm/100cm^2)
A	=	physical probe area (cm^2)
E	=	detector efficiency (4π)

Therefore

$$18.2 \text{ seconds} = \frac{13,800}{100*126*0.06}$$

Where

t	=	time period for static count(s)

C = 100 dpm/100cm^2

A = 126 cm^2

E = 6 %

Using the above equations found in Chapter 6 of MARSSIM (Rev. 1, August 2000) the probability of detecting 100 dpm/100cm^2 alpha is approximately 58 %.

7.7.17 Scan MDCs for Asphalt/Concrete Surfaces, Materials, Equipment, and Tools (Alpha, 582cm^2 probe)

The larger (582cm^2) gas proportional detectors have background count rates on the order of 5 to 10 cpm, and a single count will not cause a surveyor to investigate further. A counting period long enough to establish that a single count indicates an elevated contamination level would be prohibitively inefficient. For these types of instruments, the surveyor usually will need to get at least 2 counts while passing over the source area before stopping for further investigation.

Assuming this to be a valid assumption, the probability of getting two or more counts can be calculated by:

$$P(n \geq 2) = 1 - e^{-\frac{(GE+B)t}{60}} \left(1 + \frac{(GE+B)t}{60}\right)$$

Where

P(n≥2) = probability of getting 2 or more counts during the time interval *t*

t = d/v, dwell time over source (s)

G = contamination activity (dpm)

E = detector efficiency (4π)

B = background count rate (cpm)

The following example illustrates the calculation of the calculation of the probability for the large area gas proportional instrument with a 582 cm^2 probe area that will be used for the scan surveys that will be performed during the Final Status Survey:

$$0.85 = 1 - e^{-\frac{(100*0.05+10)10.8}{60}} \left(1 + \frac{(100*0.05+10)13.5}{60}\right)$$

Where

P(n≥2)	=	probability of getting 2 or more counts during the time interval *t*
t	=	13.5/1.00
G	=	100 dpm
E	=	5 %
B	=	10 cpm

Using the above equations found in Chapter 6 of MARSSIM (Rev. 1, August 2000) the probability of detecting 100 dpm/100cm^2 alpha is approximately 85 %.

7.8 Detection Sensitivity—Static and Scan Minimum Detectable Concentration (MDC), Gamma Surveys

7.8.1 Static MDC

The static MDC represents the smallest level of radioactivity, on a surface, that is statistically detectable by the measurement process. Equation 6 is used to calculate the MDC for gamma radiation.

Equation 6

$$MDC_{\gamma} = \frac{3 + 3.29\sqrt{R_B\, T_B}}{T_B}$$

Where:

R_B = background count rate (cpm)
T_B = background counting time (min)

7.8.2 Calculation of Static MDC for Gamma Surveys

The following calculation of the MDC in cpm γ is for a NaI instrument with a 2-inch by 2-inch probe that will be used for the direct measurement surveys of gamma radiation for the NAS Pensacola surveys. For this calculation, the observed (previous site investigation) average background count rate of 5,860 cpm for soil was used, and the measurement and background counting times were each 1 minute.

Background Count Rate: 5,860 cpm
Background Count Time: 1 min

The MDC is calculated using Equation 6:

$$MDC_{\gamma} = \frac{3 + 3.29\sqrt{5,860 \times 1}}{1} = 255\,cpm$$

7.8.3 Scanning Minimum Detectable Count Rate, Gamma

The minimum detectable number of net source counts in the scan interval, for an ideal observer, can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in *d'*) as shown in Equation 7.

Equation 7

$$MDCR = d'\sqrt{b_i}\left(\frac{60}{i}\right)$$

Where:

d' = index of sensitivity (α and β error)
b_i = number of background counts in scan time interval (count)
i = scan or observation interval(s)

7.8.4 Determination of MDCR and Use of Surveyor Efficiency, Gamma

The following is the calculation of the MDCR in cpm γ for the NaI instrument with a 2-inch by 2-inch NaI probe that will be used for the scan surveys at the NAS Pensacola. For this calculation, the observed average background count rate of 5,860 cpm will be used. It was noted that a typical source remained under the probe for 6 seconds during the scan; therefore, the average number of background counts in the observation interval was 586 [$b_i = 5,860 \times (6/60)$]. The required rate of true positives was 95 percent, and the false positives were 5 percent.

From Table 6.5 of MARSSIM (NUREG-1575; DoD et al., 2000), the value of d', representing this performance goal, is 3.28.

The minimum detectable number of net source counts, S_i, needed was calculated by multiplying 24.2 (the square root of 586) by 3.28 (the *d′* value); so, S_i equals 79.4.

The MDCR, in cpm, is then calculated by Equation 8:

Equation 8

$$MDCR = S_i \left(60 / i\right)$$

$$MDCR = 79.4\left(60 / 6\right) = 794$$

The $MDCR_{Surveyor}$ for is then calculated assuming a surveyor efficiency (p) of 0.5 and the MDCR of 794 cpm as follows:

Equation 9

$$MDCR_{SURVEYOR} = \frac{MDCR}{\sqrt{P}} = \frac{794}{\sqrt{0.5}} = 1{,}123\, cpm$$

7.8.5 Scan MDC for Gamma Surveys (2-inch by 2-inch NaI Probe)

The gamma scan MDC (in pCi/g) for land areas is based on the area of elevated activity, depth of contamination, and the radionuclide (i.e., energy and yield of gamma emissions). To establish the scan MDC, the relationship between the detector's net count rate to net exposure rate must be established first. This is accomplished by determining the MDCR using Equation 8 as shown in Section 7.8.4 and then applying a surveyor efficiency factor *p* to get $MDCR_{Surveyor}$ as calculated by Equation 9 above.

The corresponding minimum detectable exposure rate (MDER) is determined for a 2-inch by 2-inch NaI probe and the radionuclide of concern. When used with the Ludlum Model 2350-1, calibration records for the Ludlum Model 44-10 2-inch by 2-inch NaI scintillation detector provide information that can be used to determine the ratio of cpm to microroentgen per hour (µR/hr). This is accomplished with the use of a mathematical variable Ludlum refers to as the calibration constant. During calibration, the constant is determined for each detector using radiation from the isotope requested by the user, if available. By using the value of the calibration constant, as shown in Equation 10, a dose rate can be calculated for a given count rate and vice versa. The calibration constant is provided by the vendor or manufacturer during calibration of the instrument.

Equation 10

$$MDER\ (\mu R / hr) \quad = \quad \frac{MDCR_{SURVEYOR} * 6 \times 10^7}{cc}$$

Where:

$MDCR_{SURVEYOR}$ = 1,123 cpm
cc = calibration constant = 8.633059 x 10^{10} (counts/R) use radium
$6x10^7$= a conversion factor accounting for differences in time and activity units (µR-min)/(R-hr) (i.e. converts R/min to µR/hr)

The MDER is calculated using Equation 10, is 0.849µR/hr.

Modeling (using Microshield© Version 5.05 [Grove Engineering, 1996]) was used to determine the net exposure rate produced by 1 pCi/g of ^{226}Ra in soil.

The physical and geometrical factors considered in the modeling included:

- The dose point of 4 inches above the soil was used.
- The density of 1.6 grams per cubic centimeter (g/cm^3) was used for soil.
- The depth of the area of elevated activity was 15 cm.
- The circular dimension of the cylindrical area of elevated activity was 0.25 m^2.

Using the above input parameters, Microshield© Version 5.05 calculates the exposure rate to be 0.7043 µR/hr for ^{226}Ra (which accounts for buildup).

The radionuclide concentration of ^{226}Ra (scan MDC) necessary to yield the MDER (0.849 µR/hr) may be calculated using Equation 11, as follows:

Equation 11

$$^{226}Ra\ Scan\ MDC = \frac{1 pCi / g\ (0.849 \mu R / hr)}{0.7043 \mu R / hr} = 1.2\ pCi / g$$

A copy of the Microshield© Version 5.05 calculation run is included in this plan in Attachment #2.

Table 14 Typical Instrumentation for AWS Radiological Surveys

Note: Equivalent instrumentation may be used in place of the stated manufacturer or model. Instrumentation listed is anticipated at the time of development of this plan.

Type of Measurement/Area Surveyed	Meter	Detector	Bkgd. [1]	Eff. % [1]	Type of Check Source	Detection Sensitivity [1]
Surface Scans-alpha/beta Asphalt-Concrete Machinery-Equipment	Ludlum Model-2360 Data Logger	Large Area Scint. Ludlum Model 43-89 (126 cm^2)	150-200 CPM βγ 0-2 CPM α	~15 β ~25 α	100 cm^2 Tc-99 Plate Source β 100 cm^2 Th-230 Plate Source α	~ 4,400 dpm/100cm^2 βγ ~ 58 % @ 100 dpm/100cm^2 α
Surface Scans-alpha/beta Asphalt-Concrete Machinery-Equipment	Ludlum Model-2360 Data Logger	Large Area Gas Proportional Ludlum Model 43-37 (582 cm^2)	800-1000 CPM βγ 0-10 CPM α	~20 β ~20 α	100 cm^2 Tc-99 Plate Source β 100 cm^2 Th-230 Plate Source α	~ 362 dpm/100cm^2 βγ ~ 41 dpm/100cm^2 α ~ 85 % @ 100 dpm/100cm^2 α
Direct Measurements alpha/beta Machinery-Equipment (2-minute)	Ludlum Model-2360 Data Logger	Large Area Scint. Ludlum Model 43-89 (126 cm^2)	150-200 CPM βγ 0-2 CPM α	~15 β ~25 α	100 cm^2 Tc-99 Plate Source αβ 100 cm^2 Th-230 Plate Source α	~ 1,016 dpm/100cm^2 βγ ~ 78 dpm/100cm^2 α
Exposure Rate Surveys	Ludlum Model-19	Same as Meter	5 μR/hr	N/A	Cs-137 Button	2 μR/hr
Soil Surface Scans Excavation Bottom/Overburden Soils	Ludlum Model 2350-1 Data Logger	Ludlum Model 44-10 2" by 2" NaI	5000-6000 CPM γ	N/A	Cs-137 Button	1.2 pCi/g [2]
Gross alpha/beta/gamma on Swipe Samples	Ludlum Model-2929 Dual Channel Scaler	Ludlum Model 43-10-1 ZnS Scintillation Detector	50-75 CPM βγ	~32 α ~20 βγ	47 mm or equiv. Tc-99 Source β 47 mm or equiv. Th-230 Source α	~ 15-22 dpm/100cm^2 α ~ 120-180 dpm/100cm^2 βγ

[1] Actual background values, efficiencies and detection sensitivities will be calculated using actual on site conditions in accordance with Sections 7.7 and 7.8 of this plan.

[2] Theoretical, based upon calculations in Section 7.8.5 if this plan.

7.9 Statistical Considerations

7.9.1 Demonstration of Compliance

When determining compliance with remediation goals, the survey unit is examined. One measurement does not determine compliance. Rather, the site data are examined statistically. The data used for the survey results is inclusive of survey results and sample analysis. The three compliance tests are summarized in Table 15 below. They include:

- Compare the largest site measurement to the smallest background measurement.
- Compare the average site measurement to the average background measurement.

- Use the Wilcoxon Rank Sum test (MARSSIM, 2000) to determine if the site data exceeds the surface contamination and soil release limits.

Table 15 Statistical Comparisons with Release Limits

Survey Result	Conclusion
Difference between the largest survey measurement and the smallest background reference area measurement is less than the surface/soil contamination release limits.	Site meets release criterion.
Difference of survey unit and background reference area average is greater than the surface/soil contamination release limits.	Site does not meet release criterion.
Difference between any survey unit measurement and any background reference area measurement greater than the surface contamination release limits and the difference of survey unit average and background reference area average is less than the surface/soil contamination release limits.	Site meets release criterion if Wilcoxon Rank Sum test rejects the hypothesis that the survey unit exceeds the release criterion.

7.9.2 Null Hypothesis

Using the MARSSIM methodology, the null hypothesis is stated as "the residual activity in the survey unit exceeds the release criteria" (Rev. 1, August 2000). Thus, in order to pass the survey unit (that is, release the area), the null hypothesis must be rejected. If necessary, the Wilcoxon Rank Sum Test will be used on the survey data to test the statistical null hypothesis.

7.9.3 Confidence Levels

The Final Status Survey is designed to limit Type I and Type II errors to 5%. It is important to minimize the chances that area grids exceeding the release limits will be missed (Type I) and area grids meeting the release limits will be rejected as too high (Type II). The probability of either of these occurring is set at a maximum of 5%. The Critical Value for the Wilcoxon Rank Sum Test is calculated from these probability values and from the number of samples/measurements taken.

7.9.4 Wilcoxon Rank Sum Test

Since gross alpha-beta measurements (and not radionuclide specific) are being performed as part of this Final Status Survey, Chapter 8, Subsection 8.2.3 of MARSSIM suggests use of the Wilcoxon Rank Sum Test to test the statistical null hypothesis instead of the Sign Test.

The WRS test is a two-sample test that compares the distribution of a set of measurements in a survey unit to that of a set of measurements in a reference area. The test is performed by first adding the value of the release limits to each measurement in the reference area. The combined set of survey unit data and adjusted reference area data are listed, or ranked, in increasing numerical order. If the ranks of the adjusted reference site measurements are significantly higher than the ranks of the survey unit measurements, the survey unit demonstrates compliance with the release criterion. The advantage of this nonparametric test is that it does not assume the data are normally or log-normally distributed. The WRS test also allows for "less than" measurements to be present in the reference area and the survey units.

For this case, the release limit value is added to each of background reference area measurement results that were obtained in the background reference area to obtain the adjusted reference area measurement Z_i.

N is the total number of data points for each survey unit/reference area combination. The N data points are divided between the survey unit, n, and the reference area, m. The simplest method for distributing the N data points is to assign half the data points to the survey unit and half to the reference area. This means that N/2 measurements are performed in each survey unit, and N/2 measurements are performed in each reference area. If more than one survey unit is associated with a particular reference area, N/2 measurements should be performed in each survey unit and N/2 measurements should be performed in the reference area.

The *m* adjusted reference sample measurements, Z_i, from the reference area and the *n* sample measurements, Y_i, from the survey unit are pooled and ranked in order of increasing size from 1 to N, where $N = m+n$. For this case N=32.

If several measurements are tied *(i.e.*, have the same value), they are all assigned the average rank of that group of tied measurements.

If there are *t* "less than" values, they are all given the average of the ranks from 1 to *t*.

Therefore, they are all assigned the rank $t(t+1)/(2t) = (t+1)/2$, which is the average of the first *t* integers. If there is more than one detection limit, all observations below the largest detection limit should be treated as "less than" values.

The ranks of the adjusted measurements from the background reference area are then summed, W_r.

Since the sum of the first N integers is N(N+1)/2, one can equivalently sum the ranks of the measurements from the survey unit, W_s, and compute $W_r = N(N+1)/2 - W_s$.

Compare W_r with the critical value given in Table I.4 found in Appendix I of MARSSIM for the appropriate values of n, m, and α. If W_r is greater than the critical value, the hypothesis that the survey unit exceeds the release criterion is rejected.

For *n* or *m* greater than 20 the table (critical) value can be calculated using the equation:

$$n(n+m+1)/2 \; + z\sqrt{nm \; (n+m+1)/12}$$

For this case *n*=16 *m*=16 and α=0.05.

The calculated value of the Critical Value for this case is: 308.

If the test shows that the first group is larger than the second, then the release criteria is not met.

7.9.5 Soil Sampling Frequency

In order to utilize MARSSIM guidance it is assumed that there will be no radioactive contamination in the background reference area. The MARSSIM guidelines will be used and a 95 percent confidence level for detecting radioactivity above the investigation level will be assumed. Using the Wilcoxon Rank Sum Test, a release limit of 1.61 pCi/g, a LBGR value of 0.805 pCi/g (one half of the release limit value), and a Standard Deviation value of 0.48 pCi/g (conservative estimate of 30% of the release limit value) with a false negative (β) error rate of 5 percent, and a false positive error (α) rate of 5 percent, the number of survey/sampling data points can then be calculated.

The initial step in determining the number of data points is to calculate the relative shift, Δ/σ = (Release Limit Value-LBGR)/σ, from the release limit value, the lower bound of the gray region (LBGR), and the standard deviation of the contaminant in the survey unit, σ. Values of the relative shift that are less than one will result in a large number of measurements needed to demonstrate compliance.

The calculated value of the relative shift is 1.67.

The corresponding value of P_r from Table 5.4 in Chapter 5 of MARSSIM is 0.945201..

The number of direct measurement sample data points (N/2) can then be obtained directly from Table 5.3 in Chapter 5 of MARSSIM. For α = 0.05, β = 0.05 and Δ/σ = 1.67, a value of 16 is obtained for N/2. The table value has already been increased by 20% to account for missing or unusable data and uncertainty in the calculated value of N/2.

The Critical Value is 308

7.9.6 Determining Data Points for Small Areas of Elevated Activity

The $DCGL_W$ is the radioactivity level for residual radioactivity evenly distributed over a large area.

The $DCGL_{EMC}$ is used when small areas of elevated radioactivity exist within larger areas.

The statistical test described above evaluates whether or not the residual radioactivity in an area exceeds the $DCGL_W$ for contamination conditions that are approximately uniform across the survey unit. In order to obtain reasonable assurance that any small areas of elevated residual radioactivity are not missed during the final status survey the total number of samples might have to be increased.

For example per MARSSIM guidance, the scan MDC has for ^{226}Ra has been determined to be 1.2 pCi/g. The area in between the 16 sampling points calculated above for Site 12 is 47 m^2. Interpolating into Table 5.6 of MARSSIM gives an area dose factor for 47 m^2 of 2.15 for ^{226}Ra. This results in a $DCGL_{EMC}$ = 2.15 ($DCGL_W$) = 2.15(1.61) = 3.4 pCi/g. The scan MDC of 1.2 pCi/g is less than the $DCGL_{EMC}$ so no additional samples will be needed in order to find elevated areas of activity.

7.10 Survey Design

7.10.1 Class1 Areas Excavation Areas Bottom

7.10.1.1 Gamma Scan Surveys

The survey will consist of 100% gamma scan surveys using a Ludlum Mode 2350-1 Data Logger coupled to a Ludlum Model-44-10 2-inch by 2-inch NaI detector.

7.10.1.2 Soil Samples

In each survey unit, a minimum of 16 soil samples will be taken from the systematic locations (does not include biased samples) following excavation and gamma scan activities. Sixteen surface (0-15 cm below ground surface) samples will be collected from each sampling location within each excavation. The calculations that were used to obtain the number of required samples are presented in Section 7.9.5 of this plan.

Sampling equipment and tools will be wiped down and surveyed after each sample to ensure no cross contamination occurs during the sampling process. If contamination is found above the minimum detectable count rate of the survey instrument, the equipment will be decontaminated.

Approximately 300 to 500 grams of soil will be collected from each sample location. Samples will be prepared by removing vegetation, rocks, and foreign objects exceeding ¼ inch in diameter. The samples, once prepared, will be placed into an appropriate container. Collection methodology, chain of custody, and analysis requirements are detailed in AWS's SOP's. Copies of the applicable SOP's will be furnished upon request.

The samples will be sent to an off-site laboratory for gamma spectroscopy analysis.

The off-site laboratory that will be used is:

Test America Laboratories Inc.
13715 Rider Trail North
Earth City, MO 63045

7.10.2 Class1 Areas Asphalt/Concrete Surfaces

7.10.2.1 Gross Alpha/Gross Beta Scan Surveys

The survey will consist of 100% direct scan surveys for alpha-beta radiations using a large area proportional detector system (Ludlum Instruments Model 2360 Data Logger or equivalent coupled to a Ludlum Instruments Model 43-37 large area (582 cm^2) gas proportional detectors or the equivalent).

7.10.2.2 Gross Alpha/Gross Beta Direct Measurements

The survey will consist of 2-minute direct measurement surveys for alpha-beta radiations using a large area proportional detector system (Ludlum Instruments Model 2224 scaler/rate meter or equivalent coupled to a Ludlum Instruments Model 43-37 large area (582 cm^2) and Ludlum Instruments Model 43-68 large area (126 cm^2) gas proportional detectors or the equivalent).

The number of direct measurements taken (16) in the survey unit will be in accordance with Table 10 of this plan.

The spacing interval between the direct measurements will be in accordance with Table 10 of this plan.

The results of the direct measurements will be recorded on form NWT-001RCS, Radiation Contamination Survey Cover Sheet or equivalent electronic spreadsheet.

7.10.2.3 Gross Beta-Gamma-Alpha Loose Surface Contaminations Surveys

Loose surface contamination surveys of alpha and beta/gamma emitters will be performed using cloth smears.

The swipe survey will be performed by wiping over an area of 100 cm^2 (~ 4" by 4") with a cloth smear, and applying moderate pressure.

The smears will be analyzed with a Ludlum Model-2929 Dual Channel Scaler phoswich detector or equivalent in accordance with NWT Standard Operating Procedure TM-003-01-20, “Operation and Calibration of the Ludlum Model 2929 Dual Channel Scaler”.

One swipe sample will be collected at each gross alpha/beta direct measurement location.

The results of the smears will be recorded on form NWT-006, Smear Counting Analysis Report or equivalent electronic spreadsheet.

7.10.3 Class 2 Areas Asphalt/Concrete Surfaces

7.10.3.1 Gamma Scan Surveys

The survey will consist of 50% gamma scan surveys using a Ludlum Mode 2350-1 Data Logger coupled to a Ludlum Model-44-10 2-inch by 2-inch NaI detector.

7.10.3.2 Gross Alpha/Gross Beta Direct Measurements

The survey will consist of 2-minute direct measurement surveys for alpha-beta radiations using a large area proportional detector system (Ludlum Instruments Model 2224 scaler/rate meter or equivalent coupled to a Ludlum Instruments Model 43-37 large area (582 cm^2) and Ludlum Instruments Model 43-68 large area (126 cm^2) gas proportional detectors or the equivalent).

The number of direct measurements taken (16) in the survey unit will be in accordance with Table 10 of this plan.

The spacing interval between the direct measurements will be in accordance with Table 10 of this plan.

The results of the direct measurements will be recorded on form NWT-001RCS, Radiation Contamination Survey Cover Sheet or equivalent electronic spreadsheet.

7.10.3.3 Gross Beta-Gamma-Alpha Loose Surface Contaminations Surveys

Loose surface contamination surveys of alpha and beta/gamma emitters will be performed using cloth smears.

The swipe survey will be performed by wiping over an area of 100 cm^2 (~ 4" by 4") with a cloth smear, and applying moderate pressure.

The smears will be analyzed with a Ludlum Model-2929 Dual Channel Scaler phoswich detector or equivalent in accordance with NWT Standard Operating Procedure TM-003-01-20, "Operation and Calibration of the Ludlum Model 2929 Dual Channel Scaler".

One swipe sample will be collected at each gross alpha/beta direct measurement location.

The results of the smears will be recorded on form NWT-006, Smear Counting Analysis Report or equivalent electronic spreadsheet.

8.0 HEALTH AND SAFETY CONSIDERATIONS

The removal of radiologically impacted soils and Final Status surveys at the NAS Pensacola will be conducted in accordance with the applicable sections of the AWS Health and Safety Plan. Excavation health and safety considerations will be described in this plan. All on site personnel shall read and understand the contents of the plan prior to beginning work on the project. All on-site workers shall sign a statement that they have read and understand the requirements of the HASP.

8.1 Hazard Analysis

The job hazard Analysis identifies potential safety, health and environmental hazards and provides for the protection of personnel, the community, and the environment.

8.1.1 Radiological Exposure

Residual amounts of low-level radioactive material may be present in the soil in the work area at the NAS Pensacola. Personnel performing the surveys and soil removal shall wear dosimetry and modified Level D PPE as described in Sections 3.2 and 8.2.2 of this plan.

8.2 Hazard Controls

The following control measures will be implemented during the survey activities. The control measures are intended to supplement the HASP.

8.2.1 Radiation Work Permit

A Radiation Work Permit (RWP) shall be prepared and will specify the activities to be performed and all radiological control requirements and safety requirements for the work. All personnel assigned to site work will be required to read and sign the RWP acknowledging that they understand the requirements prior to beginning work.

The RWP will also be used as an information document for industrial safety. Hazards other than radiological may be included in the RWP so proper protection can be taken for all possible hazards from one controlling document. Implicit in any RWP is the need for a briefing on the radiological conditions present in the work environment.

The RWP shall list tasks and specific levels of protection for each worker covered by the RWP. The RWP shall also detail the dosimetry requirements, the protective clothing requirements, and the expected radiation and contamination levels to be encountered during the job.

8.2.2 PPE

Personnel performing the work at NAS Pensacola will wear modified Level D PPE in accordance with the PPE selection matrix in the HASP.

The modified Level D PPE will consist of:

- Steel-toed shoes;
- Hard hat;
- Safety glasses;
- Latex or equivalent gloves (when collecting soil samples).

8.2.3 Safety Equipment

In addition to other equipment specified in this work plan, the following safety equipment will be staged at the NAS Pensacola temporary office space:

- First aid kit
- Eye wash kit

8.3 Training

Personnel performing activities associated with the NAS Pensacola work activities will receive training covering this work plan.

All on-site project personnel shall have completed at least 40 hours of hazardous waste operations-related training, as required by the Occupational Safety and Health administration (OSHA) Regulation 29 CFR Part 1910.120. Those personnel who have completed the 40-hour training more than 12 months prior to start of field activities shall have completed an 8-hour refresher course within the past twelve months.

The Project Manager shall have completed an additional 8 hours of relevant supervisory health and safety training.

Personnel operating the survey detection equipment will be qualified ANSI 3.1 Senior Health Physics Technicians based on training and experience outlined in Section 4.4.6 and 4.5.3.2 of ANSI standard ANSI/ANS-3.1-1993 (ANSI/ANS, 1993).

A formal review and documentation of the key personnel qualifications to perform the required work will be made by management and verified during the pre job briefing that will be conducted prior to start of work.

The personnel will be familiar with the handling and storage of radioactive materials, contamination controls, and the use of radiation survey equipment. In addition, and discreet radioactive devices found will be stored in 55-gallon drums and placed into a secured (soil laydown/bin storage area) area of the site.

8.4 Hazard Communications

The Project Manager or designee shall ensure that crewmembers understand their obligation to safety and ensure that members are familiar with the elements of the safety program. A copy of this plan will be maintained in the on-site project office.

Daily tailgate safety meetings shall be conducted and documented as specified in the Health and Safety Plan. Material Safety Data Sheets (MSDSs) for all hazardous substances and materials that will be used on site will be maintained in the on-site project office.

9.0 QUALITY ASSURANCE

9.1 Equipment

The instruments and systems used for the work effort will be calibrated on an annual frequency using the manufacturer's calibration protocol to National Institute of Standards and Technology (NIST) traceable sources.

The survey instruments will be source checked each day prior to the start of the survey activities to verify proper operation of detectors and detection systems.

9.2 Records and Reports

The Project Manager is responsible for reviewing data for accuracy and completeness before on-site activities are concluded. Electronic records may be substituted, provided appropriate access authorization procedures are in place and quality assurance requirements are met.

All data, notes, measurements, calibrations, and other information pertinent to a survey site must be recorded and maintained. Records must conform to the following basic requirements:

- Marked with date of entry.
- Signed or initialed (by hand or electronically) by the author of the entry.
- Written or printed in a legible manner.
- Contain all pertinent information in a concise, accurate entry.

Column headings or requested information on record data forms may be inappropriate or incorrect for specific site situations. If so, appropriate handwritten changes must be made on the forms. When certain information requested on the presented form is not required, the space or columns should be crossed through or marked "NA" (not applicable) as an indication that such information was not required, rather than having possibly been forgotten.

If data corrections are necessary a single line will be drawn through the entry. New data, initials of the surveyor, and date of correction will be recorded. Data will not be obliterated by erasing or with the use of white-out.

All training records and accident investigation documents will be maintained. The training records will include brief biographies (resumes) certifications, or documents that demonstrate the qualifications of the personnel performing the work.

The Final Status Survey Report will contain records and information necessary to document and support the Final Status Survey effort. All generated records for the project shall be maintained in the on-site office. Records that must be controlled and maintained during the project and presented in the Final Status Survey Report, in addition to site activities, include but are not limited to:

- Description of survey design;
- ALARA evaluation/discussion;
- Instrument calibration data;
- Description of area to be released and it's radiological use and history;
- Daily instrument performance check data;
- Instrument efficiency determination data;
- Survey records;
- Dates surveys were performed;
- Survey results and data;
- Description of instrumentation used;
- Instrumentation MDC calculations;
- Smear sample location records;
- Identification of release limits used;
- Sample analysis results;
- Survey maps;
- Quality control data; and
- Comparison of survey results to release limits;

Listed records will be maintained on site during project activities. All listed records will be transmitted with the final project report and will be maintained at the AWS corporate office in Anchorage, AK.

9.3 Quality Control Samples

Paired duplicates of 10 % of the swipe samples will be collected and counted on site. The results of the QC duplicate samples will be compared to each other. A maximum deviation of ± 20% is the satisfactory objective of the comparison of the samples.

9.4 Data Management

Data will be maintained in the on-site office. Back up copies of data will be made routinely and maintained on the computer and/or copier provided. Further, back up copies of survey and sample results will routinely be made to CDs or other electronic media.

10.0 SURVEY PROCEDURES AND MEASUREMENT DATA INTERPRETATION

10.1 Surface Activity Measurements

Measurements to quantify surface activity levels represent the fundamental compliance measurements for buildings and structures. ISO-7503, NUREG-1507, and ASTM were used as technical guidance to ensure the accurate measurement of surface activity.

Equation 12 is used to document and calculate the surface activity in dpm per 100 cm^2.

Equation 12

$$A_S = \frac{R_{S+B} - R_B}{\varepsilon_i \varepsilon_s \frac{W_A}{100\,cm^2}}$$

Where;

A_S = total surface activity (dpm/100 cm^2)

R_{S+B} = the gross count rate of the measurement in cpm,

R_B = the background count rate in cpm

ε_ι = the instrument efficiency (counts per particle)

ε_s = the contaminated surface efficiency (particles per disintegration)

W_A = the area of the detector window (cm^2)

This equation has two efficiency terms, which account for differences between the conditions under which the detector is calibrated, and conditions under which the detector is used in the field. The instrument efficiency (ε_i) is discussed in Section 7.7.1, and is determined under ideal conditions in the laboratory. The surface efficiency is discussed in Section 7.7.3, and is used to determine the 4π total efficiency for a particular surface and condition.

10.2 Investigation Level Calculations

The gross alpha investigation levels in net cpm, discussed in Section 6.5.5.3 can be calculated using Equation 13 (for gross alpha measurements) below:

Equation 13

$$\text{Net CPM } \alpha = 100*(\varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2})$$

Where;

ε_i = instrument efficiency (counts per particle)

ε_s = contaminated surface efficiency (particles per disintegration)

W_A = area of the detector window (cm^2)

The gamma scan investigation level in gross cpm, discussed in Section 6.5.5.3 can be calculated by using Equation 14 below:

Equation 14

$$\text{Investigation Level in CPM} = R_B + 3\sigma$$

Where;

R_B = Average Background Count Rate

σ = Standard Deviation of Background Count Rate

10.3 Data Interpretation

Basic statistical quantities will be calculated for the data in order to identify patterns, relationships and any type anomaly.

The Project Manager will review data at the end of each phase of the survey to determine the validity of the results and adequate coverage of the survey areas.

11.0 WASTE MANAGEMENT

11.1 Waste Material Volume Estimate

Below is a summary of the assumptions used to calculate the total volume of waste:

- Site 12: = 13,581 ft^3 Total
- Site 27: = 27 ft^3 Total
- 13,581 ft^3 + 27 ft^3 = 13,608 ft^3 ÷ 27 = 504 yd^3 Total
- Each waste container can contain ~ 12 cubic yards due to weight restrictions

11.2 Packaging of Waste Materials

It is currently planned that soil will be packaged into 20-25 cubic yard intermodal roll-off containers with hard tops and then loaded onto flatbed rail cars. Each container will be lined with a plastic liner prior to loading. The container(s) shall meet all applicable Department of Transportation (DOT) requirements.

The waste materials, if necessary, will be wrapped with plastic as necessary to prevent the potential spread of contamination when transporting to the disposal container(s).

Once loaded, a radiological survey of the container's exterior surface will be performed and documented to ensure compliance with the applicable DOT regulations. The surveys will consist of dose rate surveys and loose surface contamination surveys.

11.3 Shipment and Disposal of the Waste Materials

It is currently planned that the waste materials will be shipped shortly after loading to the licensed disposal facility, U.S. Ecology of Grandview, ID, a permitted disposal site for this waste classification. Transportation is expected to be via rail.

A roll-off truck will be used to transport the loaded bin to the rail facility located in Wallace, AL. At the rail facility, the loaded bins will be loaded onto the rail cars with a crane. Figure 19 presents a satellite image that shows the location of the rail facility that will be used. The containers will be weighed at the truck scales located near Cavalier Field prior to transport to the rail facility.

Figure 19 Rail Facility Location Map

The waste will be classified, and all shipping manifests, appropriate DOT labeling and shipping documentation will be completed by a JMC approved broker employed by AWS prior to the containers leaving NAS Pensacola property.

Once the material is received by the disposal facility, manifests, and appropriate documents will be completed and then sent to AWS by the disposal facility. Copies of these documents will be summarized and included in the Final Report for the project.

It is currently anticipated that it will take anywhere from 45-60 days once a bin is loaded, to make it's arrival at the disposal facility.

11.4 Liquid Radioactive Waste

It is anticipated that no liquid radioactive waste will be generated.

11.5 Mixed Waste

Based upon prior soil sampling and analysis it is anticipated that no mixed waste will be generated.

11.6 Backfill of Open Excavations

If the soil sample results indicate that no further excavation is required, the open excavations will be backfilled once the sample analysis results have been received from the offsite laboratory and concurrence from RASO to backfill the areas has been received. The turnaround time on the sample analysis will be 21 days. Backfill operations will take place shortly (within a few weeks) after that.

11.7 Soil Laydown/Bin Storage Area Post Job Surveys

The area will undergo a 50% gamma scan survey following completion of work to identify areas of elevated activity. The results of the survey will be compared to the pre job survey results. If any areas exceed the investigation level (established at 3σ (standard deviations) above the established background levels) or are greater than the results of the pre job survey, further measurements will be taken to confirm the initial result, and as appropriate, to quantify the area of elevated residual radioactivity that may require further action or remediation.

In addition, 16 systematic 2- minute gross alpha-beta direct measurements will be collected in the area at the same locations that were surveyed in the pre job survey. The results of the survey will be compared to the pre job survey results. If any areas exceed the investigation level (established at 90% of the DCGL for surface contamination) or are greater than the results of the pre job survey, further measurements will be taken to confirm the initial result, and as appropriate, to quantify the area of elevated residual radioactivity that may require further action or remediation.

11.8 Excavation Boundary Surveys

Following all excavation activities in the sites, the boundaries of the excavations (i.e. corners of excavations) will be surveyed by a licensed State of Florida surveyor.

The excavation boundary survey data will be incorporated into the appropriate base drawings for future reference.

This work will be performed by Fabre Engineering and Surveying Company of Pensacola, Florida.

11.9 Area Release and Fence Removal

Once all of the survey and sampling data has been reviewed by RASO for each of the areas and found to be acceptable for unrestricted release, the temporary fencing and postings around the areas will be removed following concurrence from RASO and the Navy.

11.10 Site 12 Office Trailer

Once all remediation and backfill activities have been completed in Site 12, the office trailer previously located in the area will be placed back in the area by AAA Mobile Home Movers. All utilities will be reconnected to the trailer by Del-Jen personnel.

12.0 FINAL REPORT

After all measurements have been made and laboratory results are complete, the data will be analyzed and a report will be prepared following completion of the project. The report will include all measurements, laboratory reports (including quality control results), dose modeling, and analysis of the data. A narrative of the work and conclusions drawn from the results will be presented. Any deviations from this work plan will be noted and explained.

13.0 REFERENCES

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Attachment 1

RESRAD Version 6.4 Output Reports

Summary : RESRAD Default Parameters Industrial Worker Scenario
File   : C:\RESRAD_FAMILY\RESRAD\NAS PENSACOLA BUILDING 709.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(2)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(3)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(4)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(5)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(6)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(7)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(8)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(9)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(10)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(11)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(1)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(2)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(1)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(2)
D-34	Food transfer factors:			
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(1,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(1,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(1,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(2,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(2,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	7.900E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	6.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	6.100E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.610E+00	0.000E+00	---	S1(2)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(2)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.300E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.350E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.463E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	1.140E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	1.700E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	6.000E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	-1.000E+00	1.000E+00	-1 shows non-circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	2.750E+00	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	5.500E+00	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	8.250E+00	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	1.100E+01	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	1.375E+01	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	1.650E+01	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	1.925E+01	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	2.200E+01	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	2.475E+01	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	2.750E+01	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	3.025E+01	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	3.300E+01	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	1.000E+00	1.000E+00	---	FRACA(1)
R017	Ring 2	1.000E+00	2.732E-01	---	FRACA(2)
R017	Ring 3	8.000E-01	0.000E+00	---	FRACA(3)
R017	Ring 4	4.700E-01	0.000E+00	---	FRACA(4)
R017	Ring 5	3.500E-01	0.000E+00	---	FRACA(5)
R017	Ring 6	2.700E-01	0.000E+00	---	FRACA(6)
R017	Ring 7	2.400E-01	0.000E+00	---	FRACA(7)
R017	Ring 8	2.000E-01	0.000E+00	---	FRACA(8)
R017	Ring 9	1.800E-01	0.000E+00	---	FRACA(9)
R017	Ring 10	1.600E-01	0.000E+00	---	FRACA(10)
R017	Ring 11	1.400E-01	0.000E+00	---	FRACA(11)
R017	Ring 12	4.600E-02	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	1.000E+00	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	1.500E-01	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	2.400E+00	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	1.000E-01	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	3.000E-02	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	3.000E-07	3.000E-07	---	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	5.000E-01	5.000E-01	---	REXG
R021	Height of the building (room) (m)	2.500E+00	2.500E+00	---	HRM
R021	Building interior area factor	0.000E+00	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	-1.000E+00	-1.000E+00	code computed (time dependent)	DMFL
R021	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	790.00 square meters	Ra-226	1.610E+00
Thickness:	0.60 meters		
Cover Depth:	0.00 meters		

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	1.000E+03
TDOSE(t):	2.496E+01	2.461E+01	2.392E+01	2.165E+01	1.627E+01	5.942E+00	3.096E-01	6.132E-02
M(t):	9.985E-01	9.844E-01	9.567E-01	8.660E-01	6.508E-01	2.377E-01	1.238E-02	2.453E-03

Maximum TDOSE(t): 2.496E+01 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ra-226	2.727E+00	0.1093	2.716E-04	0.0000	2.222E+01	0.8901	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.519E-02	0.0006
Total	2.727E+00	0.1093	2.716E-04	0.0000	2.222E+01	0.8901	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.519E-02	0.0006

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ra-226	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	0.000E+00	0.0000	2.496E+01	1.0000
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	0.000E+00	0.0000	2.496E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.690E+00	0.1093	2.889E-04	0.0000	2.190E+01	0.8900	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.728E-02	0.0007
Total	2.690E+00	0.1093	2.889E-04	0.0000	2.190E+01	0.8900	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.728E-02	0.0007

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	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	0.000E+00	0.0000	2.461E+01	1.0000
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	0.000E+00	0.0000	2.461E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.616E+00	0.1094	3.202E-04	0.0000	2.128E+01	0.8898	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.111E-02	0.0009
Total	2.616E+00	0.1094	3.202E-04	0.0000	2.128E+01	0.8898	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.111E-02	0.0009

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	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	0.000E+00	0.0000	2.392E+01	1.0000
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	0.000E+00	0.0000	2.392E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.372E+00	0.1096	4.012E-04	0.0000	1.925E+01	0.8890	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.129E-02	0.0014
Total	2.372E+00	0.1096	4.012E-04	0.0000	1.925E+01	0.8890	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.129E-02	0.0014

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	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	0.000E+00	0.0000	2.165E+01	1.0000
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	0.000E+00	0.0000	2.165E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	1.795E+00	0.1103	4.726E-04	0.0000	1.443E+01	0.8871	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.220E-02	0.0026
Total	1.795E+00	0.1103	4.726E-04	0.0000	1.443E+01	0.8871	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.220E-02	0.0026

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	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	0.000E+00	0.0000	1.627E+01	1.0000
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	0.000E+00	0.0000	1.627E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	6.746E-01	0.1135	2.547E-04	0.0000	5.243E+00	0.8823	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.430E-02	0.0041
Total	6.746E-01	0.1135	2.547E-04	0.0000	5.243E+00	0.8823	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.430E-02	0.0041

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	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	0.000E+00	0.0000	5.942E+00	1.0000
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	0.000E+00	0.0000	5.942E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	4.049E-02	0.1308	1.655E-05	0.0001	2.675E-01	0.8640	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.591E-03	0.0051
Total	4.049E-02	0.1308	1.655E-05	0.0001	2.675E-01	0.8640	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.591E-03	0.0051

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

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	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	0.000E+00	0.0000	3.096E-01	1.0000
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	0.000E+00	0.0000	3.096E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ra-226	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	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	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
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.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	6.132E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.132E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.132E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.132E-02	1.0000

*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)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.550E+01	1.528E+01	1.485E+01	1.343E+01	1.008E+01	3.677E+00	1.914E-01	3.809E-02
Ra-226+D	Pb-210+D	1.000E+00	7.578E-04	2.219E-03	4.909E-03	1.221E-02	2.107E-02	1.331E-02	8.800E-04	0.000E+00
Ra-226+D	∑DSR(j)		1.550E+01	1.529E+01	1.486E+01	1.345E+01	1.011E+01	3.690E+00	1.923E-01	3.809E-02

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

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

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	1.612E+00	1.636E+00	1.683E+00	1.859E+00	2.474E+00	6.774E+00	1.300E+02	6.564E+02

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 = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ra-226	1.610E+00	0.000E+00	1.550E+01	1.612E+00	1.550E+01	1.612E+00

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

Nuclide (j)	Parent (i)	THF(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	1.000E+03
Ra-226	Ra-226	1.000E+00	2.496E+01	2.461E+01	2.391E+01	2.163E+01	1.624E+01	5.920E+00	3.082E-01	6.132E-02
Pb-210	Ra-226	1.000E+00	1.220E-03	3.573E-03	7.904E-03	1.966E-02	3.393E-02	2.143E-02	1.417E-03	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(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	1.000E+03
Ra-226	Ra-226	1.000E+00	1.610E+00	1.588E+00	1.544E+00	1.401E+00	1.060E+00	3.995E-01	2.460E-02	1.425E-06
Pb-210	Ra-226	1.000E+00	0.000E+00	4.870E-02	1.384E-01	3.822E-01	6.808E-01	4.341E-01	2.873E-02	1.665E-06

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 3.05 seconds

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Part II: Source Terms, Factors, and Parameters for Individual Pathways

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Part II: Source Terms, Factors, and Parameters for Individual Pathways

Iteration Log for Computation of the Time of Maximum Ra-226 Dose/Source Ratio
Pathway: Inhale (excluding Radon)

Tolerance for tmax = 1.0E-03 (fractional accuracy)

Iteration Number	t (years)	DSR(t) (mrem/yr)/(pCi/g)	Step Size (years)	Step Type
0	3.00000E+01	2.93519E-04		
1	2.94047E+01	2.93560E-04	-5.95315E-01	parabolic
2	2.92617E+01	2.93561E-04	-1.43025E-01	parabolic
3	2.92909E+01	2.93561E-04	1.93053E-02	parabolic
4	2.93202E+01	2.93561E-04	2.92909E-02	parabolic
5	2.92909E+01	2.93561E-04	0.00000E+00	direct

Notes:
1) Step size always from t with current largest DSR(t) .
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but DSR(t) was smaller than the previous value.

Iteration Log for Computation of the Time of Maximum Ra-226 Dose/Source Ratio

Pathway: Soil

Tolerance for tmax = 1.0E-03 (fractional accuracy)

Iteration Number	t (years)	DSR(t) (mrem/yr)/(pCi/g)	Step Size (years)	Step Type
0	3.16228E+01	2.62993E-02		
1	3.45329E+01	2.63505E-02	2.91017E+00	parabolic
2	3.41307E+01	2.63513E-02	-4.02280E-01	parabolic
3	3.42120E+01	2.63513E-02	8.13615E-02	parabolic
4	3.41778E+01	2.63513E-02	-6.50770E-03	parabolic
5	3.42462E+01	2.63513E-02	3.42120E-02	parabolic
6	3.42120E+01	2.63513E-02	0.00000E+00	direct

Notes:

1) Step size always from t with current largest DSR(t) .
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but DSR(t) was smaller than the previous value.

Iteration Log for Computation of the Time of Maximum Ra-226 Dose/Source Ratio
Pathway: Radon (water dependent)

Tolerance for tmax = 1.0E-03 (fractional accuracy)

Iteration Number	t (years)	DSR(t) (mrem/yr)/(pCi/g)	Step Size (years)	Step Type
0	5.87802E+02	4.48623E-02		
1	6.03380E+02	4.47080E-02	1.55781E+01	parabolic
2	5.68017E+02	4.49991E-02	-1.97847E+01	parabolic
3	5.23190E+02	4.49290E-02	-4.48275E+01	golden section
4	5.51563E+02	4.50464E-02	-1.64544E+01	parabolic
5	5.50601E+02	4.50469E-02	-9.61861E-01	parabolic
6	5.49111E+02	4.50472E-02	-1.48994E+00	parabolic
7	5.49660E+02	4.50472E-02	1.66937E-01	parabolic
8	5.48562E+02	4.50471E-02	-5.49111E-01	parabolic
9	5.49111E+02	4.50472E-02	0.00000E+00	direct

Notes:

1) Step size always from t with current largest DSR(t) .
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but DSR(t) was smaller than the previous value.

Iteration Log for Computation of the Time of Maximum Total Dose
Pathway: Inhale (excluding Radon)

Tolerance for tmax = 1.0E-03 (fractional accuracy)

Iteration Number	t (years)	TDOSE(t) (mrem/yr)	Step Size (years)	Step Type
0	3.00000E+01	4.72566E-04		
1	2.94047E+01	4.72632E-04	-5.95318E-01	parabolic
2	2.92616E+01	4.72634E-04	-1.43095E-01	parabolic
3	2.92908E+01	4.72634E-04	1.99172E-02	parabolic
4	2.93201E+01	4.72633E-04	2.92908E-02	parabolic
5	2.92908E+01	4.72634E-04	0.00000E+00	direct

Notes:

1) Step size always from t with current largest TDOSE(t).
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but TDOSE(t) was smaller than the previous value.

Iteration Log for Computation of the Time of Maximum Total Dose
Pathway: Soil

Tolerance for tmax = 1.0E-03 (fractional accuracy)

Iteration Number	t (years)	TDOSE(t) (mrem/yr)	Step Size (years)	Step Type
0	3.16228E+01	4.23418E-02		
1	3.45329E+01	4.24244E-02	2.91015E+00	parabolic
2	3.41307E+01	4.24256E-02	-4.02261E-01	parabolic
3	3.42119E+01	4.24257E-02	8.12152E-02	parabolic
4	3.41777E+01	4.24256E-02	-5.96834E-03	parabolic
5	3.42461E+01	4.24256E-02	3.42119E-02	parabolic
6	3.42119E+01	4.24257E-02	0.00000E+00	direct

Notes:

1) Step size always from t with current largest TDOSE(t).
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but TDOSE(t) was smaller than the previous value.

Iteration Log for Computation of the Time of Maximum Total Dose
Pathway: Radon (water dependent)

Tolerance for tmax = 1.0E-03 (fractional accuracy)

Iteration Number	t (years)	TDOSE(t) (mrem/yr)	Step Size (years)	Step Type
0	5.87802E+02	7.22284E-02		
1	6.03380E+02	7.19799E-02	1.55780E+01	parabolic
2	5.68017E+02	7.24486E-02	-1.97847E+01	parabolic
3	5.23190E+02	7.23357E-02	-4.48275E+01	golden section
4	5.51563E+02	7.25247E-02	-1.64545E+01	parabolic
5	5.50601E+02	7.25256E-02	-9.61657E-01	parabolic
6	5.49073E+02	7.25259E-02	-1.52837E+00	parabolic
7	5.49622E+02	7.25259E-02	2.50377E-01	parabolic
8	5.48523E+02	7.25258E-02	-5.49073E-01	parabolic
9	5.49073E+02	7.25259E-02	0.00000E+00	direct

Notes:

1) Step size always from t with current largest TDOSE(t).
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but TDOSE(t) was smaller than the previous value.

Source Factors for Ingrowth and Decay
Radioactivity Factors Only
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	ID(j,t) = THF(j)*S1(j,t)/S1(i,0) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	9.996E-01	9.987E-01	9.957E-01	9.871E-01	9.576E-01	8.781E-01	6.484E-01
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	3.060E-02	8.897E-02	2.666E-01	6.019E-01	9.258E-01	8.904E-01	6.576E-01

Source Factors for Ingrowth and Decay
Combined Radioactivity and Leaching Factors
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	SF(j,t) = THF(j)*S1(j,t)/S1(i,0) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	9.862E-01	9.591E-01	8.699E-01	6.583E-01	2.481E-01	1.528E-02	8.853E-07
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	3.025E-02	8.595E-02	2.374E-01	4.228E-01	2.696E-01	1.784E-02	1.034E-06

The effect of volatilization was also considered when computing the source factors for H-3 and C-14.

Parameters Used for Calculating Cover Depth and Contaminated Zone Thicknesses

Cover Erosion rate (vcv): 0.001000 m/yr
Contaminated Zone Erosion rate (vcz): 0.001000 m/yr
Water Table Drop rate (vwt): 0.001000 m/yr
Precipitation rate (Pr): 1.600000 m/yr
Cover Removal Time (Tc): 0.000E+00 yr
Overhead irrigation rate (Irr): 0.200 m/yr   Runoff coefficient (Cr): 0.200
Evapotranspiration coeff. (Ce): 0.500   Infiltration rate (In): 0.740 m/yr
Bulk soil density (rhob): 1.300 g/cm**3   Effective porosity (pe): 0.000

Radio-nuclide (i)	Distribution Coefficient Kd(i),cm**3/g	Leaching Ratio q(i)
Pb-210	1.000000E+02	2.534E-03
Ra-226	7.000000E+01	3.617E-03

Time Dependence of Source Geometry

Time Dependence of Cover Depth [Cd(i,t)]

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
	Cd(i,t) (meters)							
Pb-210	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Ra-226	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Time Dependence of Contaminated Zone Thicknesses [T(i,t)]

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
	T(i,t) (meters)							
Pb-210	6.0000E-01	5.9900E-01	5.9700E-01	5.9000E-01	5.7000E-01	5.0000E-01	3.0000E-01	0.0000E+00
Ra-226	6.0000E-01	5.9900E-01	5.9700E-01	5.9000E-01	5.7000E-01	5.0000E-01	3.0000E-01	0.0000E+00

Occupancy, Cover/Depth, and Area Factors for Ground Pathway

Occupancy Factor (FO1):	0.179
Area (A):	790. sq. meters
Initial cover depth (Cd):	0.000 meters
Initial contaminated zone thickness (T):	0.600 meters

Time Dependence of Cover/Depth Factor [FCTR_COV_DEPTH(i,t)]

Nuclide (i)	FCTR_COV_DEPTH(i,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	0.000E+00
Bi-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.998E-01	9.951E-01	0.000E+00
Bi-214	9.974E-01	9.973E-01	9.973E-01	9.971E-01	9.965E-01	9.930E-01	9.510E-01	0.000E+00
Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	0.000E+00
Pb-214	1.001E+00	1.001E+00	1.001E+00	1.001E+00	1.001E+00	1.000E+00	9.889E-01	0.000E+00
Po-210	9.992E-01	9.992E-01	9.991E-01	9.991E-01	9.988E-01	9.973E-01	9.723E-01	0.000E+00
Po-214	9.990E-01	9.990E-01	9.990E-01	9.989E-01	9.987E-01	9.970E-01	9.704E-01	0.000E+00
Po-218	9.990E-01	9.990E-01	9.990E-01	9.989E-01	9.986E-01	9.970E-01	9.703E-01	0.000E+00
Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01	9.952E-01	0.000E+00
Rn-222	9.996E-01	9.996E-01	9.995E-01	9.995E-01	9.994E-01	9.984E-01	9.798E-01	0.000E+00
Tl-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

Time Dependence of Area Factor [FCTR_AREA(i,t)]

Nuclide (i)	FCTR_AREA(i,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	8.863E-01	8.863E-01	8.863E-01	8.863E-01	8.863E-01	8.863E-01	8.863E-01	1.000E+00
Bi-210	8.650E-01	8.650E-01	8.650E-01	8.650E-01	8.650E-01	8.650E-01	8.800E-01	1.000E+00
Bi-214	8.526E-01	8.526E-01	8.526E-01	8.526E-01	8.526E-01	8.526E-01	8.639E-01	1.000E+00
Pb-210	8.899E-01	8.899E-01	8.899E-01	8.899E-01	8.899E-01	8.899E-01	8.899E-01	1.000E+00
Pb-214	8.639E-01	8.639E-01	8.639E-01	8.639E-01	8.639E-01	8.639E-01	8.788E-01	1.000E+00
Po-210	8.510E-01	8.510E-01	8.510E-01	8.510E-01	8.510E-01	8.510E-01	8.667E-01	1.000E+00
Po-214	8.479E-01	8.479E-01	8.479E-01	8.479E-01	8.479E-01	8.479E-01	8.656E-01	1.000E+00
Po-218	8.510E-01	8.510E-01	8.510E-01	8.510E-01	8.510E-01	8.510E-01	8.667E-01	1.000E+00
Ra-226	8.815E-01	8.815E-01	8.815E-01	8.815E-01	8.815E-01	8.815E-01	8.904E-01	1.000E+00
Rn-222	8.495E-01	8.495E-01	8.495E-01	8.495E-01	8.495E-01	8.495E-01	8.691E-01	1.000E+00
Tl-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

Dose Conversion and Environmental Transport Factors for the Ground Pathway (p=1)

Nuclide (i)	DCF(i,1)*	ETFG(i,t) At Time in Years (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	5.847E-03	1.587E-01	1.587E-01	1.587E-01	1.587E-01	1.587E-01	1.587E-01	1.587E-01	0.000E+00
Bi-210	3.606E-03	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.568E-01	0.000E+00
Bi-214	9.808E+00	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.521E-01	1.515E-01	1.471E-01	0.000E+00
Pb-210	2.447E-03	1.593E-01	1.593E-01	1.593E-01	1.593E-01	1.593E-01	1.593E-01	1.593E-01	0.000E+00
Pb-214	1.341E+00	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.547E-01	1.556E-01	0.000E+00
Po-210	5.231E-05	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.519E-01	1.508E-01	0.000E+00
Po-214	5.138E-04	1.516E-01	1.516E-01	1.516E-01	1.516E-01	1.516E-01	1.513E-01	1.504E-01	0.000E+00

Dose Conversion and Environmental Transport Factors for the Ground Pathway (p=1)

Nuclide (i)	DCF(i,1)*	ETFG(i,t) At Time in Years (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Po-218	5.642E-05	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.521E-01	1.519E-01	1.505E-01	0.000E+00
Ra-226	3.176E-02	1.578E-01	1.578E-01	1.578E-01	1.578E-01	1.578E-01	1.578E-01	1.586E-01	0.000E+00
Rn-222	2.354E-03	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.518E-01	1.524E-01	0.000E+00
Tl-210	0.000E+00	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01

* - Units are (mrem/yr)/(pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Dose/Source Ratios for External Radiation from the Ground (p=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,1,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.694E+00	1.670E+00	1.624E+00	1.473E+00	1.114E+00	4.187E-01	2.513E-02	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.459E-05	4.273E-05	9.453E-05	2.351E-04	4.058E-04	2.562E-04	1.706E-05	0.000E+00
Ra-226+D	∑DSR(j)		1.694E+00	1.671E+00	1.625E+00	1.473E+00	1.115E+00	4.190E-01	2.515E-02	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Inhalation Pathway, Excluding Radon (p=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,2,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.620E-04	1.598E-04	1.554E-04	1.409E-04	1.066E-04	4.020E-05	2.475E-06	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	6.720E-06	1.968E-05	4.353E-05	1.083E-04	1.869E-04	1.180E-04	7.802E-06	0.000E+00
Ra-226+D	∑DSR(j)		1.687E-04	1.794E-04	1.989E-04	2.492E-04	2.935E-04	1.582E-04	1.028E-05	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Pathway Factors for the Inhalation Pathway (radon excluded)

Area (A): 7.9000E+02 m**2
Area Factor (FA2): 1.3008E-01
Cover Depth [Cd(0)]: 0.0000E+00 m
Contaminated Zone Thickness [T(0)]: 6.0000E-01 m

Occupancy Factor (FO2): 1.2800E-01
Annual Air Intake (F12): 1.1400E+04 m**3/yr
Mass Loading (ASR2): 1.0000E-04 g/m**3
FA2 * FO2 * F12 * ASR2: 1.8981E-02 g/yr

Nuclide (i)	Depth Factor [FD(i,2,t)] (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	0.0000E+00

Dose Conversion and Environmental Transport Factors for the Inhalation Pathway, Excluding Radon (p=2)

Parent (i)	Product (j)	DCF(j,2)*	ETF(j,2,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	8.594E-03	1.898E-02	1.898E-02	1.898E-02	1.898E-02	1.898E-02	1.898E-02	1.898E-02	0.000E+00
Ra-226+D	Pb-210+D	2.320E-02	1.898E-02	1.898E-02	1.898E-02	1.898E-02	1.898E-02	1.898E-02	1.898E-02	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Parameters Used for Calculating Indoor and Outdoor Radon Flux

	*Floor Material	Cover Material	Contaminated Zone
Radon Diffusion Coefficient (m**2/s)	3.000E-07	2.000E-06	2.000E-06
Total Porosity	1.000E-01	4.000E-01	4.000E-01
Volumetric Water Content	3.000E-02	5.000E-02	3.303E-01
Bulk Density (g/cm**3)	2.400E+00	1.500E+00	1.300E+00
Rn-222 Emanation Coefficient	2.500E-01	2.500E-01	2.500E-01
Initial Thickness (m)	1.500E-01	0.000E+00	6.000E-01

Building Depth Below Ground Surface *(DMFL): -1.000E+00 (m)
Negative DMFL shows building depth adjusted (if necessary) for no penetration
of contaminated zone. Actual values used *(DMFLACT), m:

t=	0.0000E+00	1.0000E+00	3.0000E+00	1.0000E+01	3.0000E+01	1.0000E+02	3.0000E+02	1.0000E+03
DMFLACT=	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Building indoor area factor *(FAI): 0.000E+00
FAI <= 0.0 shows calculated time-dependent value based on amount of wall area
extending into the contaminated zone. Actual values used *(FAIACT):

t=	0.0000E+00	1.0000E+00	3.0000E+00	1.0000E+01	3.0000E+01	1.0000E+02	3.0000E+02	1.0000E+03
FAIACT =	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	0.0000E+00

* - Parameters are used only for indoor radon flux

Time Dependence of Outdoor Radon Flux [FLUXO(i,t)]

Nuclide	FLUXO(i,t) (pCi/m**2/s)							
(i) t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	5.8676E-01	5.7789E-01	5.6052E-01	5.0371E-01	3.7084E-01	1.2549E-01	4.8834E-03	0.0000E+00

Time Dependence of Indoor Radon Flux [FLUXI(i,t)]

Nuclide	FLUXI(i,t) (pCi/m**2/s)							
(i) t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	1.7349E-01	1.7101E-01	1.6617E-01	1.5028E-01	1.1271E-01	4.0954E-02	2.0924E-03	0.0000E+00

Parameters Used for Calculating Indoor and Outdoor Radon Concentration

Radon Vertical Dimension of Mixing (HMIX):	2.000E+00	(m)
Average Annual Wind Speed (WIND):	2.000E+00	(m/sec)
Building Room Height (HRM):	2.500E+00	(m)
Building Air Exchange Rate (REXG):	5.000E-01	(1/hr)

Time Dependence of Outdoor Radon Concentration [CRNO(i,t)]

Nuclide (i)	CRNO(i,t) (pCi/m**3) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	2.0615E+00	2.0303E+00	1.9693E+00	1.7697E+00	1.3029E+00	4.4087E-01	1.7157E-02	0.0000E+00

Time Dependence of Indoor Radon Concentration [HCONC(i,r)]

Nuclide (i)	HCONC(i,t) (pCi/m**3) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	4.9423E+02	4.8718E+02	4.7339E+02	4.2809E+02	3.2105E+02	1.1662E+02	5.9534E+00	1.3545E+00

Outdoor Working Levels of Radon [WLOTD(i,t)]

Nuclide		WLOTD(i,t) (WL)							
(i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226		2.8147E-08	2.7721E-08	2.6889E-08	2.4163E-08	1.7789E-08	6.0196E-09	2.3426E-10	0.0000E+00

Indoor Working Levels of Radon [WLIND(i,t)]

Nuclide		WLIND(i,t) (WL)							
(i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226		3.4080E-03	3.3594E-03	3.2643E-03	2.9520E-03	2.2138E-03	8.0420E-04	4.1052E-05	9.3401E-06

Fraction of Time Spent Outdoors (FOTD): 6.000E-02
Fraction of Time Spent Indoors (FIND): 1.700E-01

Dose/Source Ratios for Radon Pathway (p=9)
Subpathway: Outdoor and Indoor Radon Flux
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,9,t) - DSRRNW(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.380E+01	1.360E+01	1.322E+01	1.195E+01	8.964E+00	3.256E+00	1.662E-01	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		1.380E+01	1.360E+01	1.322E+01	1.195E+01	8.964E+00	3.256E+00	1.662E-01	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Radon Pathway (p=9)
Subpathway: Indoor Radon from Water Usage
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSRRNW(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.809E-02
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.809E-02

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Transport Time Parameters for Unsaturated Zone Stratum No. 1

Stratum thickness [h(1)]:	4.000000 m
Bulk soil material density [rhob(1)]:	1.500000 g/cm**3
Effective porosity [peuz(1)]:	0.200000
Hydraulic conductivity [Khuz(1)]:	10.000000 m/yr
Total porosity [ptuz(1)]:	0.400000
Soil specific b parameter [buz(1)]:	5.300000
Saturation ratio [sruz(1)]:	0.825763

Radio-nuclide (i)	Distribution Coefficient Kduz(i,1), cm**3/g	Retardation Factor Rduz(i,1)	Transport Time Dtuz(i,1), yr
Pb-210	1.0000E+02	4.5513E+02	4.0630E+02
Ra-226	7.0000E+01	3.1889E+02	2.8468E+02

Transport Time Parameters for Unsaturated Zone created by the Falling Water Table

Water table drop rate [vwt]:	0.001000 m/yr
Bulk soil material density [rhobaq]:	1.500000 g/cm**3
Effective porosity [peaq]:	0.200000
Hydraulic conductivity [Khaq]:	100.000000 m/yr
Total porosity [ptaq]:	0.400000
Soil specific b parameter [baq]:	5.300000
Saturation ratio [sruaq]:	0.697149

Radio-nuclide (i)	Distribution Coefficient Kdaq(i), cm**3/g	Retardation Factor Rduaq(i)	Minimum Transport Time Dtuaq(i), yr
Pb-210	1.0000E+02	5.3890E+02	4.5918E+01
Ra-226	7.0000E+01	3.7753E+02	2.1801E+01

Dilution Factor and Rise Time Parameters for Nondispersion (ND) Model

Aquifer contamination depth at well (z):	2.25700E+01 m
Depth of water intake below water table (dw):	1.00000E+01 m
Infiltration rate (In):	7.40000E-01 m/yr
Aquifer water flow rate (Vwfr):	2.00000E+00 m/yr
Hydraulic gradient (J):	2.00000E-02
Hydraulic conductivity of aquifer (Kszh):	1.00000E+02 m/yr
Contaminated zone extent parallel to gradient (l):	6.10000E+01 m
Distance below contaminated zone to water table (h):	0.40000E+01 m
Initial thickness of uncontaminated cover (Cd):	0.00000E+00 m
Initial thickness of contaminated zone (T):	0.60000E+00 m
Effective porosity of saturated zone (pesz):	0.20000E+00

Radio- nuclide (i)	Dilution Factor f(i)	Retardation Factor Rdsz(i)	Horizontal Transport Time	Onsite Tauh(i), yr	Rise Time dt(i), yr	Decay Time Parameter 1/lamda(i),yr
Pb-210	1.000E+00	3.760E+02		2.294E+03	1.016E+03	3.217E+01
Ra-226	1.000E+00	2.635E+02		1.607E+03	7.122E+02	2.308E+03

Primary Parameters Used for Calculating Water/Soil
Concentration Ratios for Groundwater Pathway Segment

Model used: Nondispersion (ND)
Bulk soil density in contaminated zone (rhob): 1.300 g/cm**3

Radio- nuclide (i)	Dilution Factor f(i)	Retardation Factor Rdcz(i)	Breakthrough Time Chain year	Single Nuclide Dt(i), yr	Rise Time dt(i), yr
Pb-210	1.000E+00	3.946E+02	3.065E+02	4.522E+02	1.016E+03
Ra-226	1.000E+00	2.765E+02	3.065E+02	3.065E+02	7.122E+02

Water/Soil Concentration Ratios [WSR(j,1,t)] for Groundwater Pathway Segment

Parent (i)	Product (j)	Thread Fraction	WSR(j,1,t) At Time in Years (pCi/L)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.413E-01
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.979E-01

Water/Soil Concentration Ratios [WSR(j,2,t)] for Surface Water Pathway Segment

Watershed Area (Aw) = 1.0000E+06 m**2
Contaminated Zone Area (A) = 7.9000E+02 m**2
Dilution Factor (f') = 7.9000E-04
Soil Density (rhob) = 1.3000E+00 kg/m**3

Parent (i)	Product (j)	Thread Fraction	WSR(j,2,t) At Time in Years (pCi/L)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.646E-04
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.723E-04

Storage Times For Contaminated Foodstuffs

k	Food Item	STOR_T(k), days
1	non-leafy plants	14.
2	leafy plants	1.
3	milk	1.
4	meat	20.
5	fish	7.
6	crustacea	7.
7	well water	1.
8	surface water	1.
9	livestock fodder	45.

Storage Time Ingrowth and Decay Factors
Storage Time for k'th Foodstuff: t = STOR_T(k), days

Parent (i)	Product (j)	Thread Fraction	STOR_ID(i,j,t) = CONCE(i,j,t)/CONCE(i,i,0) t= 1.400E+01	1.000E+00	1.000E+00	2.000E+01	7.000E+00	7.000E+00	1.000E+00	1.000E+00	4.500E+01
Pb-210	Pb-210	1.000E+00	9.988E-01	9.999E-01	9.999E-01	9.983E-01	9.994E-01	9.994E-01	9.999E-01	9.999E-01	9.962E-01
Ra-226	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
Ra-226	Pb-210	1.000E+00	1.191E-03	8.510E-05	8.510E-05	1.701E-03	5.955E-04	5.955E-04	8.510E-05	8.510E-05	3.822E-03

CONCE(i,j,t)/CONCE(i,i,0) is the concentration ratio of Product(j) at time t to Parent(i) at start of storage time.

Storage Time Correction Factors
Drinking Water from Well and/or Surface
Harvest Time = t - 2.74E-03 yr; Consumption Time = t yr

Parent	Product	Thread	CFWW(j,t,1)# At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Irrigation Water for Nonleafy Plants from Well and/or Surface
Harvest Time = t - 4.11E-02 yr; Consumption Time = t - 3.83E-02 yr

Parent	Product	Thread	CFWW(j,t,2)# At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Irrigation Water for Leafy Plants from Well and/or Surface
Harvest Time = t - 5.48E-03 yr; Consumption Time = t - 2.74E-03 yr

Parent	Product	Thread	CFWW(j,t,3)# At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Irrigation Water for Livestock (Milk) Fodder from Well and/or Surface
Harvest Time = t - 1.29E-01 yr; Consumption Time = t - 1.26E-01 yr

Parent	Product	Thread	CFWW(j,t,5)# At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Irrigation Water for Livestock (Meat) Fodder from Well and/or Surface
Harvest Time = t - 1.81E-01 yr; Consumption Time = t - 1.78E-01 yr

Parent (i)	Product (j)	Thread Fraction	CFWW(j,t,7)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Livestock (Milk) Water from Well and/or Surface
Harvest Time = t - 5.48E-03 yr; Consumption Time = t - 2.74E-03 yr

Parent (i)	Product (j)	Thread Fraction	CFWW(j,t,4)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Livestock (Meat) Water from Well and/or Surface
Harvest Time = t - 5.75E-02 yr; Consumption Time = t - 5.48E-02 yr

Parent (i)	Product (j)	Thread Fraction	CFWW(j,t,6)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Nonleafy Plants
Harvest Time = t - 3.83E-02 yr; Consumption Time = t yr

Parent (i)	Product (j)	Thread Fraction	CF3(j,1,t)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.001E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Leafy Plants
Harvest Time = t - 2.74E-03 yr; Consumption Time = t yr

Parent (i)	Product (j)	Thread Fraction	CF3(j,2,t)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Livestock (Meat) Fodder
Harvest Time = t - 1.78E-01 yr; Consumption Time = t - 5.48E-02 yr

Parent (i)	Product (j)	Thread Fraction	CFLF(j,1,t)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	9.999E-01	9.999E-01	9.999E-01	9.999E-01	9.999E-01	9.999E-01	9.999E-01
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.601E+00	1.177E+00	1.053E+00	1.020E+00	1.010E+00	1.009E+00	1.002E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Livestock (Milk) Fodder
Harvest Time = t - 1.26E-01 yr; Consumption Time = t - 2.74E-03 yr

Parent (i)	Product (j)	Thread Fraction	CFLF(j,2,t)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	9.999E-01	9.999E-01	9.999E-01	9.999E-01	9.999E-01	9.999E-01	9.999E-01
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.565E+00	1.174E+00	1.053E+00	1.020E+00	1.010E+00	1.009E+00	1.002E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Meat
Harvest Time = t - 5.48E-02 yr; Consumption Time = t yr

Parent (i)	Product (j)	Thread Fraction	CF45(j,1,t)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.148E+00	1.053E+00	1.017E+00	1.006E+00	1.003E+00	1.002E+00	1.001E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Milk

Harvest Time = t - 2.74E-03 yr; Consumption Time = t yr

Parent (i)	Product (j)	Thread Fraction	CF45(j,2,t)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.018E+00	1.007E+00	1.002E+00	1.001E+00	1.000E+00	1.000E+00	1.000E+00

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Fish & Crustacea

Harvest Time = t - 1.92E-02 yr; Consumption Time = t yr

Parent (i)	Product (j)	Thread Fraction	CFF(j,1,t)# At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226+D	Pb-210+D	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.995E-01

#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Root Uptake from Contaminated Soil (q=1)

Area Factor for Plant Foods [FA(3)] = 0.40

Nuclide (i)	Depth Factor FD(i,1,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	6.6667E-01	6.6556E-01	6.6333E-01	6.5556E-01	6.3333E-01	5.5556E-01	3.3333E-01	0.0000E+00
Ra-226	6.6667E-01	6.6556E-01	6.6333E-01	6.5556E-01	6.3333E-01	5.5556E-01	3.3333E-01	0.0000E+00

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Foliar Uptake from Contaminated Dust (q=2)

Area Factor for Plant Foods [FA(3)] = 0.40

Nuclide (i)	Depth Factor FD(i,2,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	0.0000E+00
Ra-226	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	0.0000E+00

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Ditch Irrigation (q=3)

Area Factor for Plant Foods [FA(3)] = 0.40

Nuclide (i)	Depth Factor FD(i,3,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
Ra-226	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Overhead Irrigation (q=4)

Area Factor for Plant Foods [FA(3)] = 0.40

The Depth Factor Value
FD(i,p,q,t) = 1.0000E+00
is applicable for all radionuclides(i) and times(t).

Area and Depth Factors for Meat (p=4) and Milk (p=5) Pathways
Transfer from Livestock Water (q=5) and Soil (q=6) Intake

Area Factor for Meat and Milk [FA(p),p=4,5] = 0.04

The livestock water subpathway (q=5) and livestock soil intake subpathway (q=6)
occur only for the meat (p=4) and milk (p=5) pathways.

Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Root Uptake from Contaminated Soil (q=1)

Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,1,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Foliar Uptake from Contaminated Dust (q=2)

Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,2,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Ditch Irrigation (q=3)

Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,3,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Overhead Irrigation (q=4)

Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,4,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)

Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,1,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)

Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,2,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Ditch Irrigation (q=3)

Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,3,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Overhead Irrigation (q=4)

Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,4,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Livestock Water (q=5)

Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,5,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)

Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,1,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)

Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,2,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Ditch Irrigation (q=3)

Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,3,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Overhead Irrigation (q=4)

Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,4,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)

Subpathway: Livestock Water (q=5)

Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,5,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Fish Pathway (p=6)

Parent (i)	Product (j)	DCF(j,6)*	ETF(j,6,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Drinking Water Pathway (p=7)

Parent (i)	Product (j)	DCF(j,7)*	ETF(j,7,t) * SF(j,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Root Uptake from Contaminated Soil (q=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,3,1t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Foliar Uptake from Contaminated Dust (q=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,3,2t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Ditch Irrigation (q=3)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,3,3t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Overhead Irrigation (q=4)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,3,4t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Total for All Subpathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent	Product	Thread	DSR(j,3,t) At Time in Years (mrem/yr)/(pCi/g)							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,4,1t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,4,2t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Ditch Irrigation (q=3)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,4,3t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Overhead Irrigation (q=4)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,4,4t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Livestock Water (q=5)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,4,5t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Total for All Subpathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,4,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,5,1t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,5,2t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Ditch Irrigation (q=3)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,5,3t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Overhead Irrigation (q=4)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,5,4t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Livestock Water (q=5)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,5,5t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Total for All Subpathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,5,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from the Ingestion of Fish (p=6)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,6,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose/Source Ratios for Internal Radiation from the Ingestion of Drinking Water (p=7)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent	Product	Thread	DSR(j,7,t) At Time in Years (mrem/yr)/(pCi/g)							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Plant/Air and Plant/Water Concentration Ratios

Mass loading [ASR(3)]: 1.000E-04 g/m**3
Area Factor for Mass Loading [FA(2)]: 1.301E-01

Nuclide (i)	FAR(i,3,2,1) m**3/g	FAR(i,3,2,2) m**3/g	FWR(i,3,3,1) L/g	FWR(i,3,3,2) L/g	FWR(i,3,4,1) L/g	FWR(i,3,4,2) L/g
Pb-210	5.4545E-02	2.6156E-01	1.1324E-06	1.6647E-06	3.4522E-04	1.6554E-03
Ra-226	5.4545E-02	2.6156E-01	4.5281E-06	6.6555E-06	3.4522E-04	1.6554E-03

FAR(i,p,q,k) is the plant/air concentration ratio for airborne contaminated dust, and FWR(i,p,q,k) is the plant/water concentration ratio. See groundwater displays for water/soil concentration ratios.

Plant/Soil Concentration Ratios, FSR(i,3,q,k,t)

Root Uptake (q=1) and Foliar Dust Deposition (q=2)
Nonleafy (k=1) and/or Leafy (k=2) Vegetables

Nuclide(i) Parent	Product	FSR(i,3,1,k)	FSR(i,3,2,1)	FSR(i,3,2,2)
Ra-226+D	Ra-226+D	4.0000E-02	7.0953E-07	3.4024E-06
Ra-226+D	Pb-210+D	1.0000E-02	7.0953E-07	3.4024E-06

Plant/Soil Concentration Ratio, FSR(j,3,q,k,t)
Ditch Irrigation (q=3)

Parent (i)	Product (j)	Thread Fraction	FSR(j,3,3,k,t) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.810E-06
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.771E-07

Plant/Soil Concentration Ratio, FSR(j,3,q,k,t)
Overhead Irrigation (q=4) and Nonleafy Vegetables (k=1)

Parent (i)	Product (j)	Thread Fraction	FSR(j,3,4,1,t) * SF(j,t) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.904E-04
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.064E-04

Plant/Soil Concentration Ratio, FSR(j,3,q,k,t)
Overhead Irrigation (q=4) and Leafy Vegetables (k=2)

Parent (i)	Product (j)	Thread Fraction	FSR(j,3,4,2,t) * SF(j,t) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.393E-03
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.898E-04

Meat/Fodder, Milk/Fodder, Fodder/Air and Fodder/Water Concentration Ratios

FI(4,q): 68.0 kg/day FI(5,q): 55.0 kg/day q=1,2,3,4
FI(4,q): 50.0 L/day FI(5,q): 160.0 L/day q=5
FI(4,q): 0.5 kg/day FI(5,q):

Nuclide (i)	FQR(i,4) d/kg	FQR(i,5) d/kg	FAR(i,3,2,3) m**3/g	FWR(i,3,3,3) L/g	FWR(i,3,4,3) L/g
Pb-210	8.0000E-04	3.0000E-04	2.8659E-01	5.3311E-07	1.8139E-03
Ra-226	1.0000E-03	1.0000E-03	2.8659E-01	2.1322E-06	1.8139E-03

FI(p,q) are the fodder (q=1,2,3,4), livestock water (q=5) and soil (q=6) intake rates; FQR(i,p) are the transfer coefficients from contaminated fodder of livestock water to meat (p=4) or milk (p=5). FAR(i,3,2,3) are the fodder/air concentration ratios, and FWR(i,3,3,3) and FWR(i,3,4,3) are the fodder/water concentration ratios for ditch and overhead irrigation, respectively.

Fodder/Soil Concentration Ratios, QSR(i,p,q,t), for Meat and Milk Pathways
Root Uptake (q=1) and Foliar Dust Deposition (q=2)

Nuclide(i) Parent	Product	QSR(i,p,1)	QSR(i,p,2)
Ra-226+D	Ra-226+D	4.0000E-02	3.7280E-06
Ra-226+D	Pb-210+D	1.0000E-02	3.7280E-06

Fodder/Soil Concentration Ratio, QSR(j,p,q,t),for Meat and Milk Pathways
Ditch Irrigation (q=3)

Parent (i)	Product (j)	Thread Fraction	QSR(j,p,3,t) * SF(j,t) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Fodder/Soil Concentration Ratio, QSR(j,p,q,t),for Meat and Milk Pathways
Overhead Irrigation (q=4)

Parent (i)	Product (j)	Thread Fraction	QSR(j,p,4,t) * SF(j,t) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Fodder/Soil Concentration Ratio, QSR(j,p,q,t),for Meat and Milk Pathways
Livestock Water (q=5)

Parent (i)	Product (j)	Thread Fraction	QSR(j,p,5,t) * SF(j,t) At Time in Years 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Meat/Soil Concentration Ratios, FSR(i,4,q,t)
Root Uptake (q=1) and Foliar Dust Deposition (q=2)

Nuclide(i) Parent	Product	FSR(i,4,1)	FSR(i,4,2)
Ra-226+D	Ra-226+D	1.8133E-03	2.5350E-07
Ra-226+D	Pb-210+D	0.0000E+00	0.0000E+00

Meat/Soil Concentration Ratio, FSR(j,4,q,t)
Ditch Irrigation (q=3)

Parent	Product	Thread	FSR(j,4,3,t) * SF(j,t) At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.220E-07
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.765E-08

Meat/Soil Concentration Ratio, FSR(j,4,q,t)
Overhead Irrigation (q=4)

Parent	Product	Thread	FSR(j,4,4,t) * SF(j,t) At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.038E-04
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.909E-05

Meat/Soil Concentration Ratio, FSR(j,4,q,t)
Livestock Water (q=5)

Parent	Product	Thread	FSR(j,4,5,t) * SF(j,t) At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.207E-05
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.392E-05

Milk/Soil Concentration Ratios, FSR(i,5,q,t)
Root Uptake (q=1) and Foliar Dust Deposition (q=2)

Nuclide(i) Parent	Product	FSR(i,5,1)	FSR(i,5,2)
Ra-226+D	Ra-226+D	1.4667E-03	2.0504E-07
Ra-226+D	Pb-210+D	0.0000E+00	0.0000E+00

Milk/Soil Concentration Ratio, FSR(j,5,q,t)
Ditch Irrigation (q=3)

Parent	Product	Thread	FSR(j,5,3,t) * SF(j,t) At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.866E-08
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.353E-09

Milk/Soil Concentration Ratio, FSR(j,5,q,t)
Overhead Irrigation (q=4)

Parent	Product	Thread	FSR(j,5,4,t) * SF(j,t) At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.393E-05
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.792E-05

Milk/Soil Concentration Ratio, FSR(j,5,q,t)
Livestock Water (q=5)

Parent	Product	Thread	FSR(j,5,5,t) * SF(j,t) At Time in Years							
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.346E-04
Ra-226+D	Pb-210+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.870E-05

Dose/Source Ratios for Soil Ingestion Pathway (p=8)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,8,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	8.700E-03	8.579E-03	8.343E-03	7.568E-03	5.727E-03	2.159E-03	1.329E-04	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	7.365E-04	2.157E-03	4.771E-03	1.187E-02	2.048E-02	1.293E-02	8.551E-04	0.000E+00
Ra-226+D	∑DSR(j)		9.436E-03	1.074E-02	1.311E-02	1.944E-02	2.621E-02	1.509E-02	9.880E-04	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Dose Conversion and Environmental Transport Factors for the Soil Ingestion Pathway (p=8)

Parent (i)	Product (j)	DCF(j,8)*	ETF(j,8,t) At Time in Years (g/yr) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.321E-03	6.632E+00	6.632E+00	6.632E+00	6.632E+00	6.632E+00	6.632E+00	6.632E+00	0.000E+00
Ra-226+D	Pb-210+D	7.276E-03	6.632E+00	6.632E+00	6.632E+00	6.632E+00	6.632E+00	6.632E+00	6.632E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(1,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(2,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(1,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(2,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(1,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(2,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Pb-210+D	2.66E-09	8.81E-10	SLPF(1,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(2,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(1,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(2,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)							
(i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	3.570E-09	1.587E-01	1.587E-01	1.587E-01	1.587E-01	1.587E-01	1.587E-01	1.587E-01	0.000E+00
Bi-210	2.760E-09	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.568E-01	0.000E+00
Bi-214	7.480E-06	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.521E-01	1.515E-01	1.471E-01	0.000E+00
Pb-210	1.410E-09	1.593E-01	1.593E-01	1.593E-01	1.593E-01	1.593E-01	1.593E-01	1.593E-01	0.000E+00
Pb-214	9.820E-07	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.548E-01	1.547E-01	1.556E-01	0.000E+00
Po-210	3.950E-11	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.519E-01	1.508E-01	0.000E+00
Po-214	3.860E-10	1.516E-01	1.516E-01	1.516E-01	1.516E-01	1.516E-01	1.513E-01	1.504E-01	0.000E+00
Po-218	4.260E-11	1.522E-01	1.522E-01	1.522E-01	1.522E-01	1.521E-01	1.519E-01	1.505E-01	0.000E+00
Ra-226	2.290E-08	1.578E-01	1.578E-01	1.578E-01	1.578E-01	1.578E-01	1.578E-01	1.586E-01	0.000E+00
Rn-222	1.740E-09	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.518E-01	1.524E-01	0.000E+00
Tl-210	0.000E+00	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01	1.790E-01

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	3.056E-02	0.000E+00	0.000E+00	0.000E+00	1.068E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.068E+01

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	9.592E+05	9.240E+05	6.992E+05	5.652E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	9.592E+05	9.240E+05	6.992E+05	5.652E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	6.677E-09	0.0002	5.924E-09	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.317E-07	0.0052
Ra-226	4.398E-05	0.9915	1.824E-08	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.160E-07	0.0026
Total	4.399E-05	0.9916	2.416E-08	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.477E-07	0.0078

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Pb-210	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	2.443E-07	0.0055
Ra-226	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	4.411E-05	0.9945
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	4.436E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.626E-05	7.180E-05	9.104E-05	1.781E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	3.626E-05	7.180E-05	9.104E-05	1.781E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ra-226	4.399E-05	0.1044	2.416E-08	0.0001	3.772E-04	0.8948	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.477E-07	0.0008
Total	4.399E-05	0.1044	2.416E-08	0.0001	3.772E-04	0.8948	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.477E-07	0.0008

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	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	0.000E+00	0.0000	4.215E-04	1.0000
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	0.000E+00	0.0000	4.215E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	9.244E-04	0.000E+00	0.000E+00	0.000E+00	3.230E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.230E-01
Ra-226	3.014E-02	0.000E+00	0.000E+00	0.000E+00	1.053E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.053E+01

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	9.455E+05	9.108E+05	6.892E+05	5.572E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	9.455E+05	9.108E+05	6.892E+05	5.572E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	7.088E-09	0.0002	6.289E-09	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.460E-07	0.0056
Ra-226	4.337E-05	0.9910	1.799E-08	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.144E-07	0.0026
Total	4.338E-05	0.9912	2.427E-08	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.604E-07	0.0082

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	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	2.594E-07	0.0059
Ra-226	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	4.350E-05	0.9941
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	4.376E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.574E-05	7.078E-05	8.974E-05	1.755E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	3.574E-05	7.078E-05	8.974E-05	1.755E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	4.338E-05	0.1044	2.427E-08	0.0001	3.718E-04	0.8947	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.604E-07	0.0009
Total	4.338E-05	0.1044	2.427E-08	0.0001	3.718E-04	0.8947	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.604E-07	0.0009

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	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	0.000E+00	0.0000	4.155E-04	1.0000
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	0.000E+00	0.0000	4.155E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	2.627E-03	0.000E+00	0.000E+00	0.000E+00	9.178E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.178E-01
Ra-226	2.931E-02	0.000E+00	0.000E+00	0.000E+00	1.024E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.024E+01

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
  and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	9.188E+05	8.850E+05	6.697E+05	5.414E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	9.188E+05	8.850E+05	6.697E+05	5.414E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	7.834E-09	0.0002	6.951E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.719E-07	0.0064
Ra-226	4.217E-05	0.9902	1.749E-08	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.113E-07	0.0026
Total	4.218E-05	0.9904	2.444E-08	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.832E-07	0.0090

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Pb-210	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	2.867E-07	0.0067
Ra-226	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	4.230E-05	0.9933
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	4.259E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.473E-05	6.877E-05	8.720E-05	1.705E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	3.473E-05	6.877E-05	8.720E-05	1.705E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ra-226	4.218E-05	0.1045	2.444E-08	0.0001	3.612E-04	0.8945	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.832E-07	0.0009
Total	4.218E-05	0.1045	2.444E-08	0.0001	3.612E-04	0.8945	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.832E-07	0.0009

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	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	0.000E+00	0.0000	4.038E-04	1.0000
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	0.000E+00	0.0000	4.038E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	7.255E-03	0.000E+00	0.000E+00	0.000E+00	2.535E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.535E+00
Ra-226	2.658E-02	0.000E+00	0.000E+00	0.000E+00	9.288E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.288E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	8.309E+05	8.003E+05	6.056E+05	4.896E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	8.309E+05	8.003E+05	6.056E+05	4.896E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	9.760E-09	0.0003	8.659E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.387E-07	0.0087
Ra-226	3.825E-05	0.9878	1.586E-08	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.009E-07	0.0026
Total	3.826E-05	0.9880	2.452E-08	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.396E-07	0.0114

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	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	3.571E-07	0.0092
Ra-226	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	3.836E-05	0.9908
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	3.872E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.140E-05	6.218E-05	7.884E-05	1.542E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	3.140E-05	6.218E-05	7.884E-05	1.542E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	3.826E-05	0.1047	2.452E-08	0.0001	3.266E-04	0.8940	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.396E-07	0.0012
Total	3.826E-05	0.1047	2.452E-08	0.0001	3.266E-04	0.8940	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.396E-07	0.0012

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Ra-226	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	0.000E+00	0.0000	3.654E-04	1.0000
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	0.000E+00	0.0000	3.654E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	1.292E-02	0.000E+00	0.000E+00	0.000E+00	4.515E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.515E+00
Ra-226	2.012E-02	0.000E+00	0.000E+00	0.000E+00	7.029E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.029E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
  and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	6.231E+05	6.002E+05	4.542E+05	3.672E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	6.231E+05	6.002E+05	4.542E+05	3.672E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	1.143E-08	0.0004	1.014E-08	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.968E-07	0.0135
Ra-226	2.892E-05	0.9828	1.201E-08	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.638E-08	0.0026
Total	2.894E-05	0.9832	2.215E-08	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.732E-07	0.0161

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Pb-210	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	4.184E-07	0.0142
Ra-226	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	2.901E-05	0.9858
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	2.943E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.354E-05	4.661E-05	5.911E-05	1.156E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.354E-05	4.661E-05	5.911E-05	1.156E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ra-226	2.894E-05	0.1055	2.215E-08	0.0001	2.449E-04	0.8927	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.732E-07	0.0017
Total	2.894E-05	0.1055	2.215E-08	0.0001	2.449E-04	0.8927	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.732E-07	0.0017

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio- Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Ra-226	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	0.000E+00	0.0000	2.743E-04	1.0000
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	0.000E+00	0.0000	2.743E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	8.239E-03	0.000E+00	0.000E+00	0.000E+00	2.879E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.879E+00
Ra-226	7.583E-03	0.000E+00	0.000E+00	0.000E+00	2.650E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.650E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.263E+05	2.180E+05	1.650E+05	1.334E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.263E+05	2.180E+05	1.650E+05	1.334E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	6.148E-09	0.0006	5.452E-09	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.133E-07	0.0192
Ra-226	1.087E-05	0.9768	4.526E-09	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.879E-08	0.0026
Total	1.088E-05	0.9774	9.977E-09	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.420E-07	0.0217

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	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	2.249E-07	0.0202
Ra-226	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	1.091E-05	0.9798
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	1.113E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	8.537E-06	1.691E-05	2.144E-05	4.193E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	8.537E-06	1.691E-05	2.144E-05	4.193E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

(Radionuclides)

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	1.088E-05	0.1089	9.977E-09	0.0001	8.881E-05	0.8886	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.420E-07	0.0024
Total	1.088E-05	0.1089	9.977E-09	0.0001	8.881E-05	0.8886	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.420E-07	0.0024

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	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	0.000E+00	0.0000	9.994E-05	1.0000
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	0.000E+00	0.0000	9.994E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	5.453E-04	0.000E+00	0.000E+00	0.000E+00	1.905E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.905E-01
Ra-226	4.670E-04	0.000E+00	0.000E+00	0.000E+00	1.632E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.632E-01

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.155E+04	1.113E+04	8.422E+03	6.808E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.155E+04	1.113E+04	8.422E+03	6.808E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	4.022E-10	0.0006	3.540E-10	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.385E-08	0.0208
Ra-226	6.493E-07	0.9750	2.787E-10	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.773E-09	0.0027
Total	6.497E-07	0.9756	6.327E-10	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.562E-08	0.0235

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Pb-210	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	1.460E-08	0.0219
Ra-226	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	6.514E-07	0.9781
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	6.660E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	4.311E-07	8.539E-07	1.083E-06	2.118E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	1.431E-08	2.838E-08	3.598E-08	7.038E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	4.454E-07	8.823E-07	1.119E-06	2.188E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ra-226	6.497E-07	0.1226	6.327E-10	0.0001	4.485E-06	0.8462	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.562E-08	0.0029
Total	6.497E-07	0.1226	6.327E-10	0.0001	4.485E-06	0.8462	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.562E-08	0.0029

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	1.491E-07	0.0281	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.300E-06	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	1.491E-07	0.0281	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.300E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	2.625E+03	2.532E+03	1.916E+03	1.549E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.625E+03	2.532E+03	1.916E+03	1.549E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	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	0.000E+00	0.0000
Ra-226	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	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	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Pb-210	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	0.000E+00	0.0000
Ra-226	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	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	0.000E+00	0.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	1.175E-07	2.330E-07	2.954E-07	5.778E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.175E-07	2.330E-07	2.954E-07	5.778E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ra-226	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	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	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	1.224E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.224E-06	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	1.224E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.224E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 2

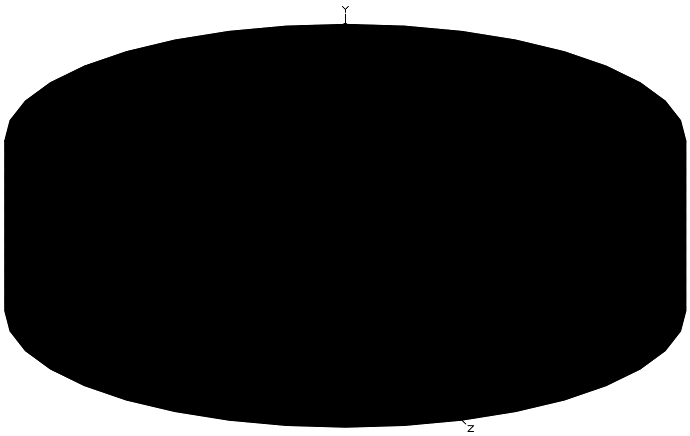
Microshield© Calculations

MicroShield v5.05 (5.05-00565)
New_World_Environmental,_Inc.

Page : 1
DOS File: RSCANMDC.MS5
Run Date: March 1, 2010
Run Time: 2:38:41 PM
Duration: 00:00:00

File Ref:
Date:
By:
Checked:

Case Title: Scan MDC Ra-226
Description: MARSSIM Default Model to Calculate Scan MDC
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	15.0 cm	5.9 in
Radius	28.209 cm	11.1 in

Dose Points

	X	Y	Z
# 1	0 cm	25.16 cm	0 cm
	0.0 in	9.9 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.75e+04 cm³	Concrete	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Bi-210	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Bi-214	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Pb-210	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Pb-214	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Po-210	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Po-214	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Po-218	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Ra-226	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002
Rn-222	5.9998e-008	2.2199e+003	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

Radial	20
Circumferential	10
Y Direction (axial)	10

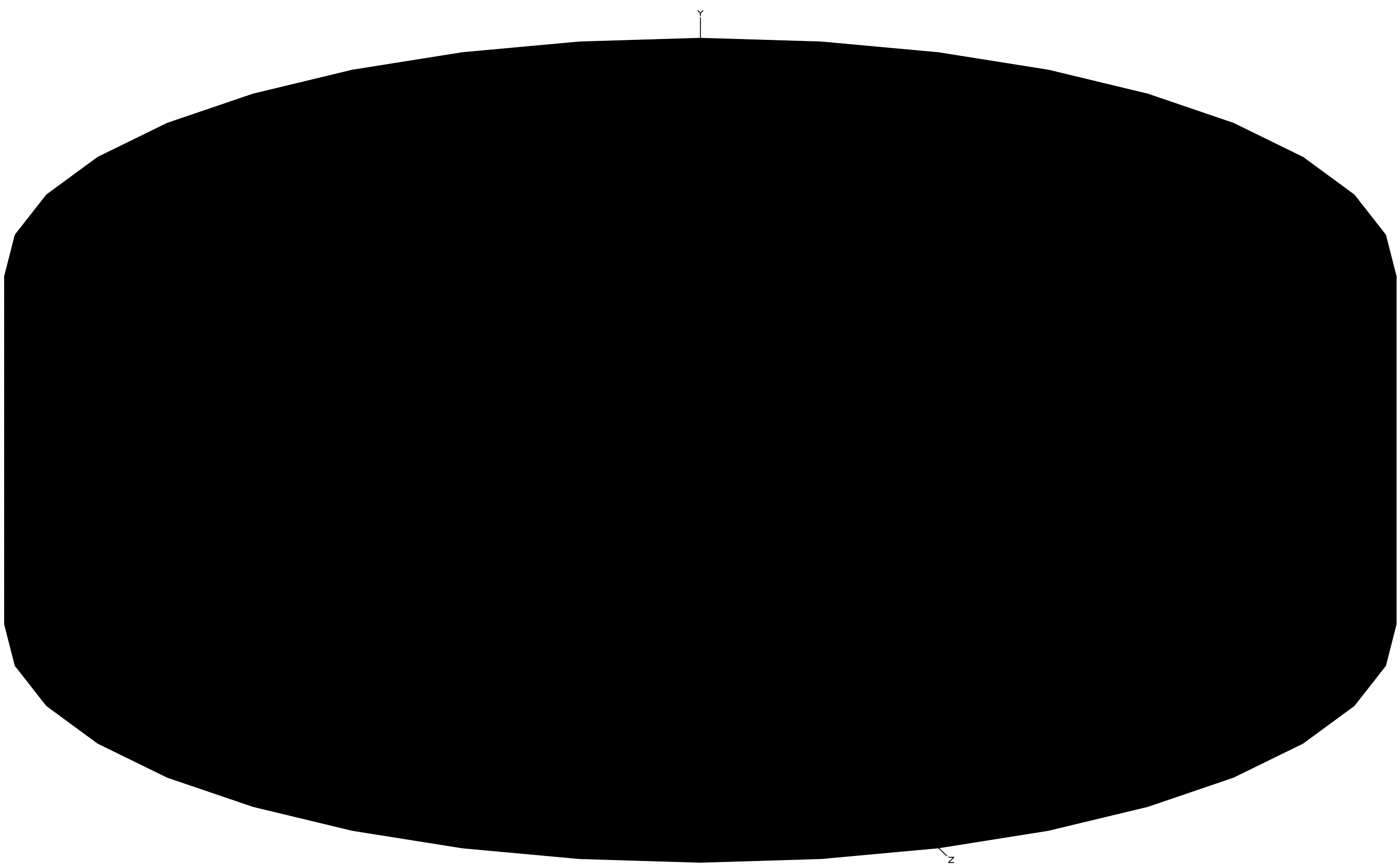
Results

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
0.05	1.144e+02	8.368e-05	1.370e-04	2.229e-07	3.650e-07
0.08	5.118e+02	1.061e-03	2.549e-03	1.678e-06	4.034e-06

Page : 2
DOS File: RSCANMDC.MS5
Run Date: March 1, 2010
Run Time: 2:38:41 PM
Duration: 00:00:00

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
0.1	3.013e+00	9.049e-06	2.373e-05	1.384e-08	3.631e-08
0.2	2.391e+02	1.881e-03	4.807e-03	3.319e-06	8.483e-06
0.3	4.581e+02	6.120e-03	1.402e-02	1.161e-05	2.659e-05
0.4	8.495e+02	1.651e-02	3.453e-02	3.218e-05	6.728e-05
0.5	3.966e+01	1.032e-03	2.013e-03	2.025e-06	3.951e-06
0.6	1.070e+03	3.532e-02	6.491e-02	6.893e-05	1.267e-04
0.8	2.098e+02	1.007e-02	1.698e-02	1.915e-05	3.229e-05
1.0	6.951e+02	4.458e-02	7.073e-02	8.218e-05	1.304e-04
1.5	4.226e+02	4.568e-02	6.547e-02	7.686e-05	1.101e-04
2.0	5.941e+02	9.225e-02	1.250e-01	1.426e-04	1.932e-04
TOTALS:	5.208e+03	2.546e-01	4.011e-01	4.408e-04	7.035e-04

Page   : 3
DOS File: RSCANMDC.MS5
Run Date: March 1, 2010
Run Time: 2:38:41 PM
Duration: 00:00:00



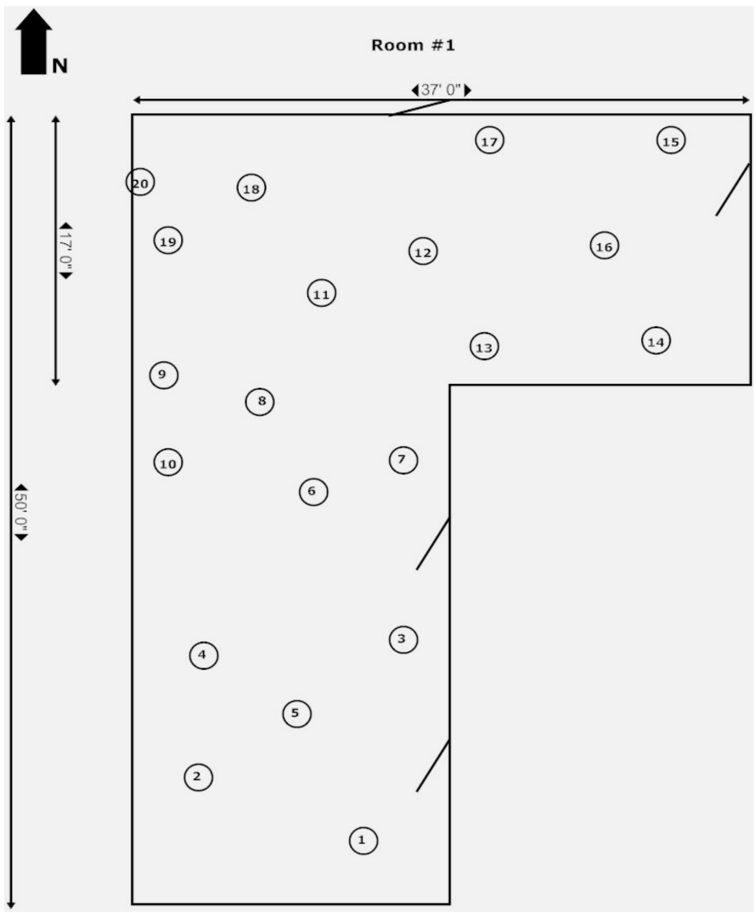
Attachment 3

Building 780 Room Surveys

RADIATION/CONTAMINATION SURVEY FORM

	INSTRUMENTATION USED						
DATE: 8/27/2009 TIME: 12:20	Model Inst/Det.	Serial Number	Calibration Due Date	Instrument % Efficiency	Total % Efficiency	MDC/MDA + (dpm/100cm²)	Background + (dpm/100cm²)
	2360	193668	5/28/2010	α 42.00%	α 10.50%	α 14.29	α 0.00
SURVEY NUMBER: N/A	43-93	277373		βγ 33.00%	βγ 8.25%	βγ 522.31	βγ 1939.39
	2929	60019	6/16/2010	α 73.00%	α 18.25%	α 16.28	α 1.10
LOCATION: NAS Pensacola				βγ 48.00%	βγ 12.00%	βγ 176.45	βγ 298.33
SURVEYOR: Thomas Wilson							
DATE: 9/3/2009 TIME: 0800							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

Description of drawing: Building 780 Room #1



Comments:

Routine (Daily / Weekly / Monthly) ☐ Non-routine ☒

- (#) denotes swipe location and fixed α/β readings
- # denotes G/A radiation readings
- # / # denotes contact / 1 meter radiation readings.
- * denotes highest radiation reading on contact
- LAW denotes large area masslinn wipe
- Δ denotes static location.
- K denotes 1,000 cpm gamma
- All readings in μr/hr unless otherwise noted
- ☆ denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: Thomas Wilson | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				4.8	169.7	-1.1	26.7	
2				4.8	812.1	1.6	-31.7	
3				0.0	151.5	1.6	10.0	
4				23.8	418.2	-1.1	-19.2	
5				4.8	418.2	1.6	18.3	
6				4.8	0.0	-1.1	60.0	
7				9.5	78.8	-1.1	-35.8	
8				14.3	278.8	-1.1	39.2	
9				14.3	375.8	-1.1	43.3	
10				19.0	339.4	1.6	-60.8	
11				9.5	690.9	1.6	30.8	
12				14.3	539.4	-1.1	10.0	
13				9.5	193.9	-1.1	22.5	
14				0.0	242.4	-1.1	30.8	
15				9.5	236.4	4.4	26.7	
16				4.8	-66.7	-1.1	26.7	
17				14.3	-60.6	-1.1	14.2	
18				14.3	442.4	-1.1	-35.8	
19				4.8	333.3	-1.1	1.7	
20				19.0	987.9	-1.1	-2.5	
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Reviewer Daniel Spicuzza	Date: 9/3/2009 Time: 0800	

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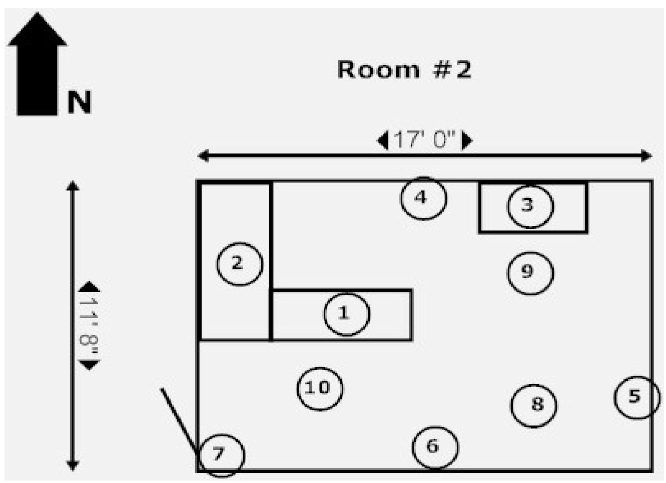
RADIATION/CONTAMINATION SURVEY FORM

	INSTRUMENTATION USED						
DATE: 8/27/2009 TIME: 12:30	Model Inst/Det.	Serial Number	Calibration Due Date	Instrument % Efficiency	Total % Efficiency	MDC/MDA + (dpm/100cm²)	Background + (dpm/100cm²)
	2360	156371	5/28/2010	α 43.00%	α 10.75%	α 13.95	α 0.00
SURVEY NUMBER: N/A	43-93	268606		βγ 34.00%	βγ 8.50%	βγ 579.55	βγ 2482.35
	2929	60019	6/16/2010	α 73.00%	α 18.25%	α 16.28	α 1.10
LOCATION: NAS Pensacola				βγ 48.00%	βγ 12.00%	βγ 176.45	βγ 298.33

SURVEYOR: James Young
DATE: 9/3/2009 TIME: 1030
Reviewed By: Daniel Spicuzza
Isotopes of Concern: ^{226}Ra Static Count Time: 2 Minutes

Description of drawing: Building 780 Room #2



Comments:

Routine (Daily / Weekly / Monthly) [ ]   Non-routine [X]

Symbol	Meaning
(#)	denotes swipe location and fixed α/β readings
#	denotes G/A radiation readings
# / #	denotes contact / 1 meter radiation readings.
*	denotes highest radiation reading on contact
LAW	denotes large area masslinn wipe
Δ	denotes static location.
K	denotes 1,000 cpm gamma
	All readings in μr/hr unless otherwise noted
☆	denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: James Young | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				4.7	-370.6	-1.1	30.8	
2				9.3	-535.3	-1.1	-35.8	
3				4.7	-229.4	-1.1	-40.0	
4				4.7	-594.1	1.6	43.3	
5				18.6	-152.9	-1.1	-15.0	
6				4.7	-547.1	-1.1	-35.8	
7				4.7	-729.4	-1.1	-19.2	
8				0.0	-305.9	1.6	39.2	
9				14.0	-117.6	-1.1	60.0	
10				4.7	-341.2	-1.1	5.8	
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Reviewer Daniel Spicuzza	Date: 9/3/2009 Time: 1030	

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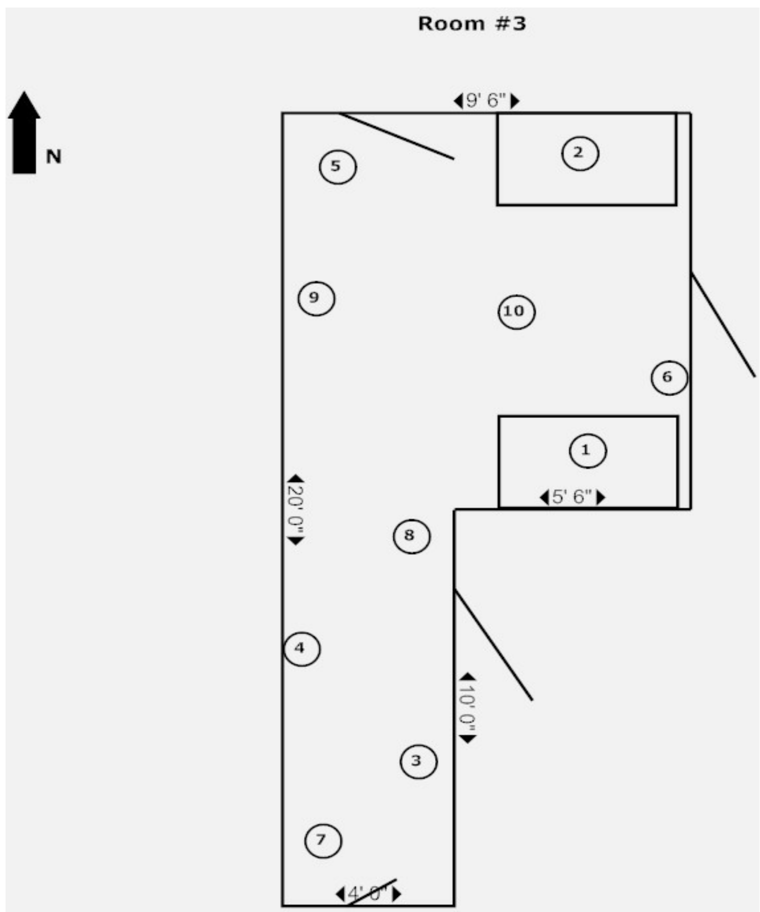
DATE: TIME: 8/27/2009 13:45	**INSTRUMENTATION USED**						
	Model Inst/Det.	**Serial Number**	**Calibration Due Date**	**Instrument % Efficiency**	**Total % Efficiency**	**MDC/MDA + (dpm/100cm²)**	**Background + (dpm/100cm²)**
SURVEY NUMBER: N/A	2360 / 43-93	156371 / 268606	5/28/2010	α 43.00% / βγ 34.00%	α 10.75% / βγ 8.50%	α 35.58 / βγ 588.79	α 4.65 / βγ 2564.71
LOCATION: NAS Pensacola	2929	60019	6/16/2010	α 76.00% / βγ 48.00%	α 19.00% / βγ 12.00%	α 13.37 / βγ 175.99	α 0.53 / βγ 296.67
SURVEYOR: James Young							
DATE: TIME: 9/2/2009 1300							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

Description of drawing: Building 780 Room #3



Comments:

Routine (Daily / Weekly / Monthly) [ ]   Non-routine [X]

(#)	denotes swipe location and fixed α/β readings
#	denotes G/A radiation readings
# / #	denotes contact / 1 meter radiation readings.
*	denotes highest radiation reading on contact
LAW	denotes large area masslinn wipe
Δ	denotes static location.
K	denotes 1,000 cpm gamma
	All readings in µr/hr unless otherwise noted
☆	denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: James Young | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				-4.7	117.6	-0.5	65.8	
2				-4.7	-476.5	-0.5	-30.0	
3				18.6	-88.2	-0.5	20.0	
4				4.7	-223.5	-0.5	20.0	
5				0.0	-388.2	-0.5	-13.3	
6				14.0	323.5	-0.5	-13.3	
7				-4.7	-82.4	4.7	-34.2	
8				-4.7	-547.1	2.1	-25.8	
9				0.0	-364.7	-0.5	107.5	
10				0.0	-641.2	-0.5	-9.2	
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Reviewer	Date: 9/2/2009	
Daniel Spicuzza	Time: 1300	

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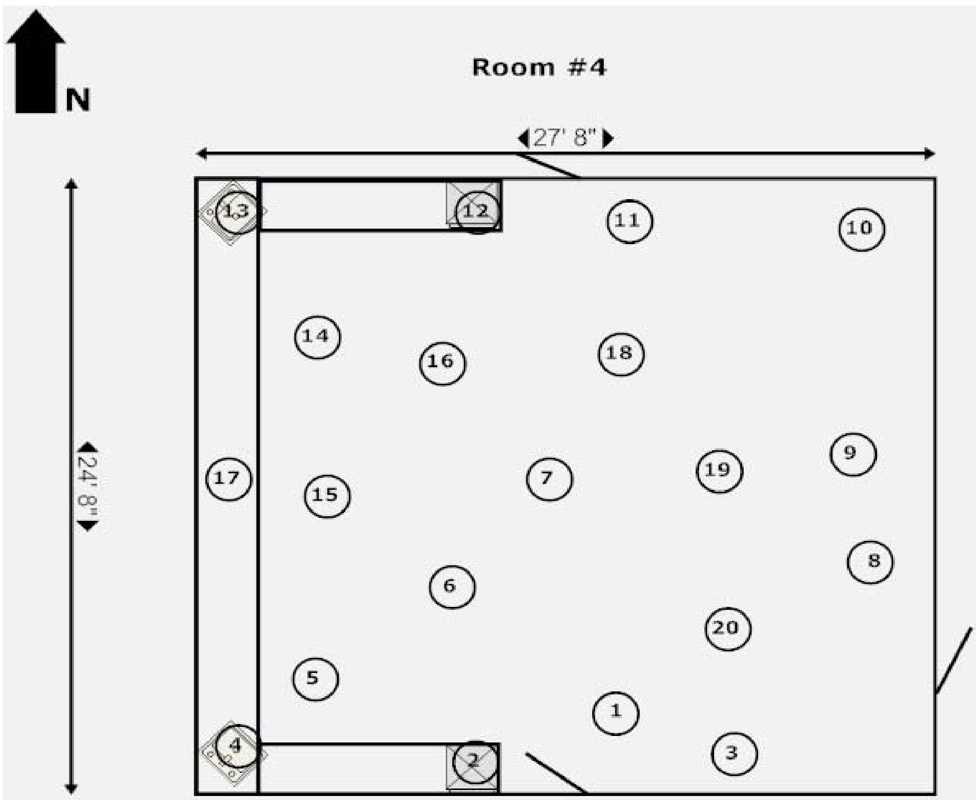
DATE: TIME: 8/27/2009 15:00	**INSTRUMENTATION USED**						
	Model Inst/Det.	**Serial Number**	**Calibration Due Date**	**Instrument % Efficiency**	**Total % Efficiency**	**MDC/MDA + (dpm/100cm²)**	**Background + (dpm/100cm²)**
SURVEY NUMBER: N/A	2360 / 43-93	193668 / 277373	5/28/2010	α 42.00% / βγ 33.00%	α 10.50% / βγ 8.25%	α 36.43 / βγ 586.03	α 4.76 / βγ 2460.61
LOCATION: NAS Pensacola	2929	60019	6/16/2010	α 76.00% / βγ 48.00%	α 19.00% / βγ 12.00%	α 13.37 / βγ 175.99	α 0.53 / βγ 296.67
SURVEYOR: Thomas Wilson							
DATE: TIME: 9/3/2009 0905							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

Description of drawing: Building 780 Room #4



Comments:

(#)	denotes swipe location and fixed α/β readings
#	denotes G/A radiation readings
# / #	denotes contact / 1 meter radiation readings.
*	denotes highest radiation reading on contact
LAW	denotes large area masslinn wipe
Δ	denotes static location.
K	denotes 1,000 cpm gamma
	All readings in μr/hr unless otherwise noted
☆	denotes solid sample location

Routine (Daily / Weekly / Monthly) [ ] Non-routine [X]

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: Thomas Wilson | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				4.8	-436.4	-0.5	32.5	
2				4.8	-193.9	-0.5	24.2	
3				9.5	-351.5	-0.5	70.0	
4				0.0	163.6	-0.5	-25.8	
5				4.8	-357.6	-0.5	-0.8	
6				9.5	121.2	-0.5	65.8	
7				23.8	-218.2	4.7	45.0	
8				9.5	-375.8	2.1	70.0	
9				9.5	-169.7	-0.5	11.7	
10				0.0	-345.5	-0.5	-38.3	
11				4.8	-363.6	2.1	53.3	
12				9.5	54.5	4.7	32.5	
13				9.5	60.6	-0.5	-0.8	
14				9.5	-339.4	2.1	3.3	
15				4.8	-36.4	-0.5	28.3	
16				0.0	-115.2	-0.5	24.2	
17				4.8	-42.4	-0.5	-5.0	
18				9.5	-18.2	-0.5	70.0	
19				4.8	-121.2	-0.5	-0.8	
20				4.8	-678.8	-0.5	36.7	
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Reviewer	Date: 9/3/2009	
Daniel Spicuzza	Time: 0905	

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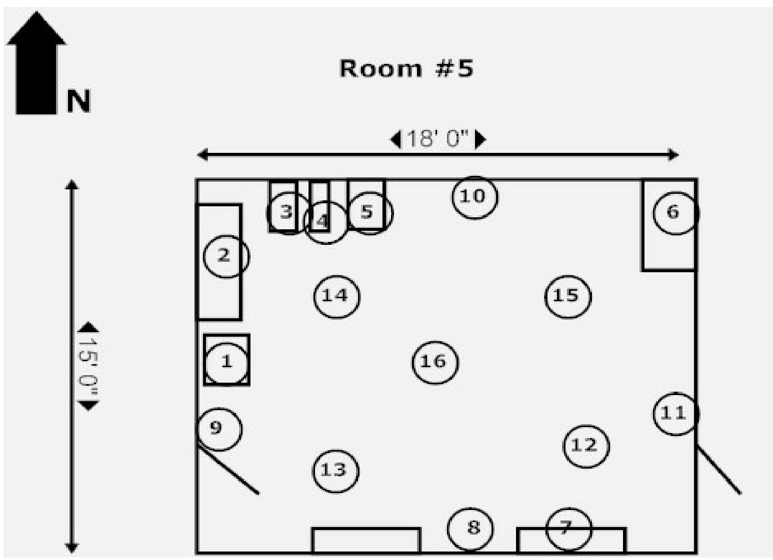
RADIATION/CONTAMINATION SURVEY FORM

		INSTRUMENTATION USED						
DATE: 9/1/2009	TIME: 13:20	Model Inst/Det.	Serial Number	Calibration Due Date	Instrument % Efficiency	Total % Efficiency	MDC/MDA + (dpm/100cm²)	Background + (dpm/100cm²)
SURVEY NUMBER:	N/A	2360	193668	5/28/2010	α 42.00%	α 10.50%	α 14.29	α 0.00
		43-93	277373		βγ 32.00%	βγ 8.00%	βγ 574.75	βγ 2287.50
LOCATION:	NAS Pensacola	2929	60019	6/16/2010	α 76.00%	α 19.00%	α 13.37	α 0.53
					βγ 48.00%	βγ 12.00%	βγ 177.36	βγ 301.67
SURVEYOR:	James Young							
DATE: 9/3/2009	TIME: 1130							
Reviewed By:	Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra		Static Count Time: 2 Minutes						

Description of drawing: Building 780 Room #5



Comments:

Routine (Daily / Weekly / Monthly) [ ] Non-routine [X]

(#) denotes swipe location and fixed α/β readings
# denotes G/A radiation readings
/ # denotes contact / 1 meter radiation readings.
* denotes highest radiation reading on contact
LAW denotes large area masslinn wipe
Δ denotes static location.
K denotes 1,000 cpm gamma
All readings in μr/hr unless otherwise noted
☆ denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: James Young | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm²	Beta/Gamma dpm/100cm²	Alpha dpm/100cm²	Beta/Gamma dpm/100cm²	
1				9.5	237.5	-0.5	-10.0	
2				0.0	50.0	-0.5	-39.2	
3				0.0	-250.0	-0.5	10.8	
4				4.8	-31.3	-0.5	81.7	
5				0.0	-25.0	2.1	-18.3	
6				19.0	300.0	-0.5	-39.2	
7				19.0	275.0	2.1	48.3	
8				9.5	637.5	-0.5	56.7	
9				28.6	-275.0	-0.5	-22.5	
10				9.5	-112.5	-0.5	-1.7	
11				14.3	756.3	-0.5	-18.3	
12				9.5	81.3	2.1	-35.0	
13				9.5	212.5	-0.5	35.8	
14				4.8	56.3	-0.5	19.2	
15				4.8	131.3	-0.5	-30.8	
16				0.0	18.8	-0.5	15.0	
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Reviewer	Date: 9/3/2009
Daniel Spicuzza	Time: 1130

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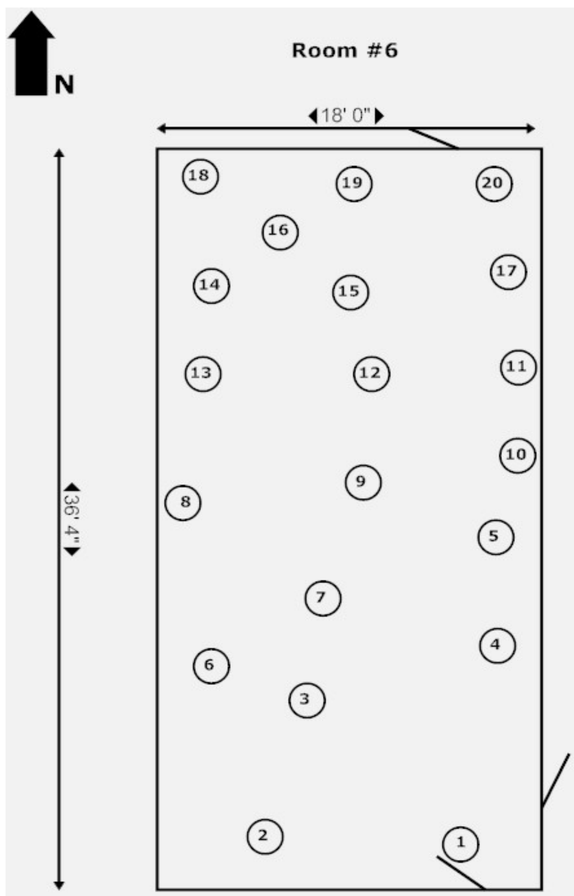
RADIATION/CONTAMINATION SURVEY FORM

DATE: 9/1/2009 TIME: 13:50	**INSTRUMENTATION USED**						
	Model Inst/Det.	**Serial Number**	**Calibration Due Date**	**Instrument % Efficiency**	**Total % Efficiency**	**MDC/MDA + (dpm/100cm²)**	**Background + (dpm/100cm²)**
SURVEY NUMBER: N/A	2360 / 43-93	156371 / 268606	5/28/2010	α 42.00% / βγ 34.00%	α 10.50% / βγ 8.50%	α 36.43 / βγ 574.20	α 4.76 / βγ 2435.29
LOCATION: NAS Pensacola	2929	60019	6/16/2010	α 76.00% / βγ 48.00%	α 19.00% / βγ 12.00%	α 13.37 / βγ 177.36	α 0.53 / βγ 301.67
SURVEYOR: Thomas Wilson							
DATE: 9/3/2009 TIME: 0905							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

Description of drawing: Building 780 Room #6



Comments:

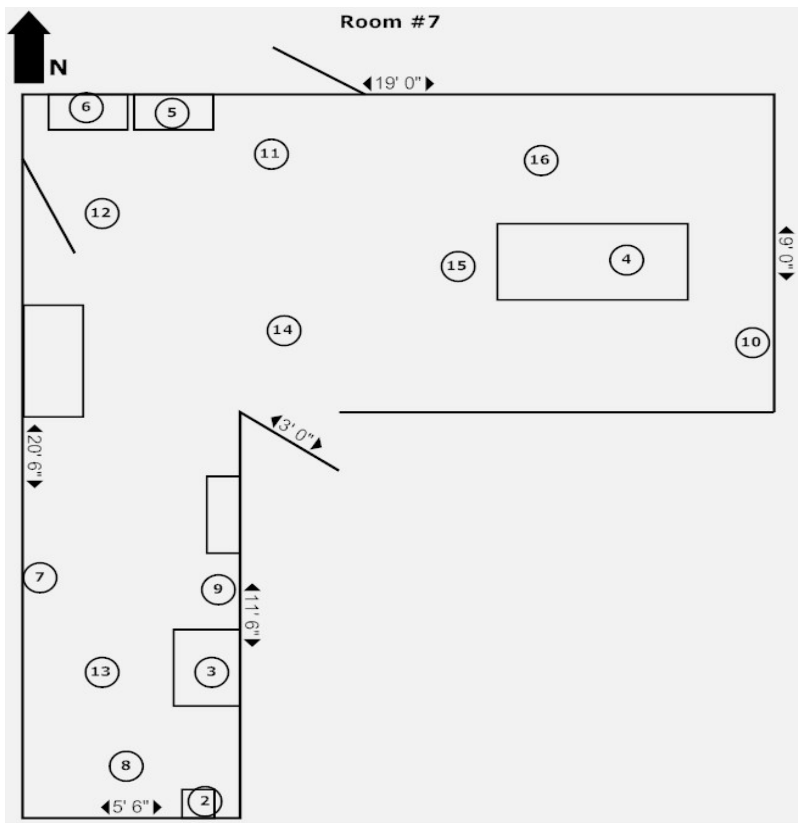
Routine (Daily / Weekly / Monthly) [ ] Non-routine [X]

(#) denotes swipe location and fixed α/β readings
# denotes G/A radiation readings
/ # denotes contact / 1 meter radiation readings.
* denotes highest radiation reading on contact
LAW denotes large area masslinn wipe
Δ denotes static location.
K denotes 1,000 cpm gamma
All readings in μr/hr unless otherwise noted
☆ denotes solid sample location

RADIATION/CONTAMINATION SURVEY FORM

	INSTRUMENTATION USED						
DATE: 9/1/2009 TIME: 13:00	Model Inst/Det.	Serial Number	Calibration Due Date	Instrument % Efficiency	Total % Efficiency	MDC/MDA + (dpm/100cm²)	Background + (dpm/100cm²)
	2360	193668	5/28/2010	α 42.00%	α 10.50%	α 14.29	α 0.00
SURVEY NUMBER: N/A	43-93	277373		βγ 32.00%	βγ 8.00%	βγ 616.48	βγ 2643.75
	2929	60019	6/16/2010	α 76.00%	α 19.00%	α 13.37	α 0.53
LOCATION: NAS Pensacola				βγ 48.00%	βγ 12.00%	βγ 177.36	βγ 301.67
SURVEYOR: James Young							
DATE: 9/3/2009 TIME: 0900							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

Description of drawing: Building 780 Room #7



Comments:

Routine (Daily / Weekly / Monthly) ☐ Non-routine ☒ X

- (#) denotes swipe location and fixed α/β readings
- # denotes G/A radiation readings
- # / # denotes contact / 1 meter radiation readings.
- * denotes highest radiation reading on contact
- LAW denotes large area masslinn wipe
- Δ denotes static location.
- K denotes 1,000 cpm gamma
- All readings in μr/hr unless otherwise noted
- ☆ denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: James Young | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				9.5	-250.0	-0.5	2.5	
2				4.8	-400.0	-0.5	-72.5	
3				9.5	-487.5	-0.5	19.2	
4				4.8	-225.0	-0.5	-14.2	
5				9.5	206.3	-0.5	-1.7	
6				4.8	225.0	2.1	-1.7	
7				19.0	-687.5	-0.5	-55.8	
8				9.5	-656.3	-0.5	-18.3	
9				19.0	-418.8	-0.5	-80.8	
10				4.8	-281.3	-0.5	-35.0	
11				4.8	343.8	2.1	-35.0	
12				4.8	-418.8	-0.5	-1.7	
13				9.5	-500.0	2.1	60.8	
14				4.8	-143.8	-0.5	-22.5	
15				0.0	-243.8	2.1	-14.2	
16				4.8	-918.8	-0.5	2.5	
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Reviewer	Date:	9/3/2009
Daniel Spicuzza	Time:	0900

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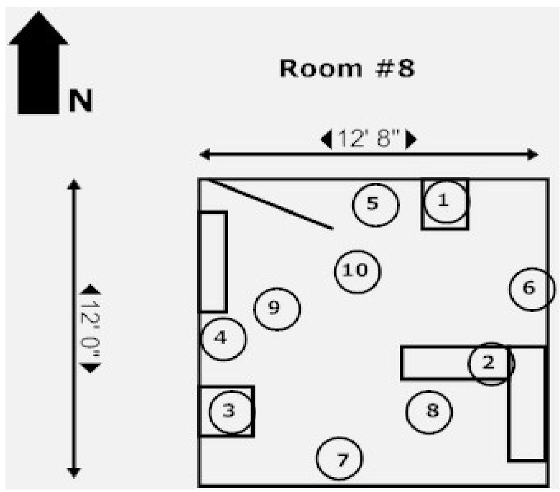
DATE: TIME:	INSTRUMENTATION USED						
8/27/2009 14:15	Model Inst/Det.	Serial Number	Calibration Due Date	Instrument % Efficiency	Total % Efficiency	MDC/MDA + (dpm/100cm²)	Background + (dpm/100cm²)
	2360	156371	5/28/2010	α 42.00%	α 10.50%	α 36.43	α 4.76
SURVEY NUMBER: N/A	43-93	268606		βγ 34.00%	βγ 8.50%	βγ 572.85	βγ 2423.53
	2929	60019	6/16/2010	α 76.00%	α 19.00%	α 13.37	α 0.53
LOCATION: NAS Pensacola				βγ 48.00%	βγ 12.00%	βγ 177.36	βγ 301.67
SURVEYOR: James Young							
DATE: TIME:							
9/3/2009 1030							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

Description of drawing: Building 780 Room #8



Comments:

Routine (Daily / Weekly / Monthly) ☐ Non-routine X

- (#) denotes swipe location and fixed α/β readings
- # denotes G/A radiation readings
- # / # denotes contact / 1 meter radiation readings.
- * denotes highest radiation reading on contact
- LAW denotes large area masslinn wipe
- Δ denotes static location.
- K denotes 1,000 cpm gamma
- All readings in μr/hr unless otherwise noted
- ☆ denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: James Young | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				0.0	200.0	-0.5	-26.7	
2				0.0	5.9	-0.5	65.0	
3				9.5	170.6	-0.5	2.5	
4				19.0	-388.2	-0.5	-5.8	
5				9.5	-176.5	-0.5	15.0	
6				0.0	811.8	-0.5	27.5	
7				9.5	-170.6	-0.5	27.5	
8				9.5	23.5	-0.5	56.7	
9				-4.8	170.6	-0.5	-14.2	
10				-4.8	-70.6	-0.5	27.5	
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Reviewer	Date: 9/3/2009
Daniel Spicuzza	Time: 1030

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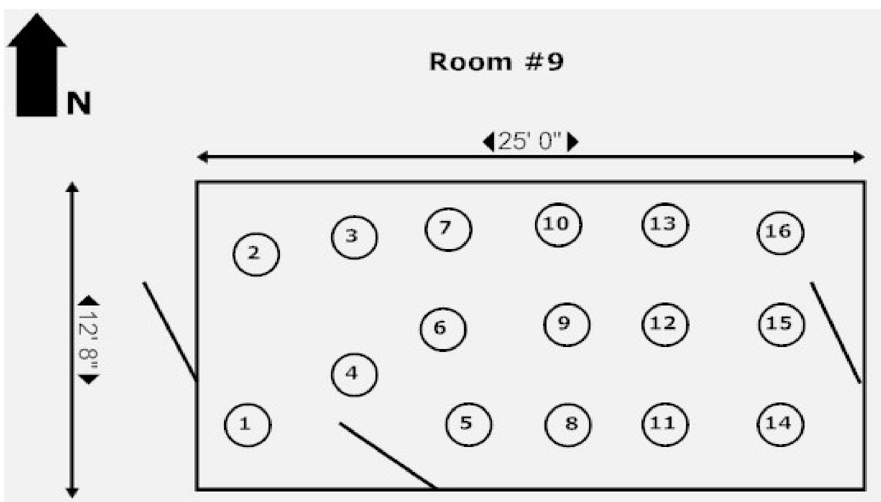
RADIATION/CONTAMINATION SURVEY FORM Page 1 of 2

DATE: 9/1/2009 TIME: 13:15	Model Inst/Det.	Serial Number	Calibration Due Date	Instrument % Efficiency	Total % Efficiency	MDC/MDA + (dpm/100cm²)	Background + (dpm/100cm²)
	2360	156371	5/28/2010	α 42.00%	α 10.50%	α 36.43	α 4.76
SURVEY NUMBER: N/A	43-93	268606		βγ 34.00%	βγ 8.50%	βγ 588.79	βγ 2564.71
	2929	60019	6/16/2010	α 76.00%	α 19.00%	α 13.37	α 0.53
LOCATION: NAS Pensacola				βγ 48.00%	βγ 12.00%	βγ 177.36	βγ 301.67
SURVEYOR: Thomas Wilson							
DATE: 9/3/2009 TIME: 0900							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

(INSTRUMENTATION USED)

Description of drawing: Building 780 Room #9



Comments:

Routine (Daily / Weekly / Monthly) ☐ Non-routine ☒ X

- (#) denotes swipe location and fixed α/β readings
- # denotes G/A radiation readings
- # / # denotes contact / 1 meter radiation readings.
- * denotes highest radiation reading on contact
- LAW denotes large area masslinn wipe
- Δ denotes static location.
- K denotes 1,000 cpm gamma
- All readings in μr/hr unless otherwise noted
- ☆ denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: Thomas Wilson | LOCATION: NAS Pensacola

Location	Exposure Rate (µR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				4.8	-376.5	-0.5	-5.8	
2				9.5	-423.5	-0.5	40.0	
3				0.0	-347.1	-0.5	6.7	
4				14.3	-458.8	-0.5	31.7	
5				9.5	247.1	-0.5	40.0	
6				4.8	-476.5	-0.5	10.8	
7				14.3	-311.8	-0.5	-30.8	
8				9.5	-294.1	2.1	-5.8	
9				19.0	-564.7	-0.5	69.2	
10				9.5	-523.5	2.1	35.8	
11				4.8	-341.2	2.1	35.8	
12				4.8	-600.0	-0.5	40.0	
13				0.0	-252.9	-0.5	-5.8	
14				-4.8	-329.4	-0.5	73.3	
15				4.8	-458.8	-0.5	2.5	
16				0.0	-335.3	-0.5	15.0	
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Reviewer	Date: 9/3/2009	
Daniel Spicuzza	Time: 0900	

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RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: Thomas Wilson | LOCATION: NAS Pensacola

Location	Exposure Rate (μR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				4.8	-405.9	-0.5	-10.0	
2				-4.8	52.9	2.1	-30.8	
3				4.8	29.4	2.1	6.7	
4				0.0	-252.9	-0.5	35.8	
5				0.0	-100.0	-0.5	10.8	
6				19.0	388.2	-0.5	-1.7	
7				0.0	164.7	-0.5	-14.2	
8				9.5	464.7	-0.5	27.5	
9				14.3	58.8	-0.5	2.5	
10				0.0	-258.8	2.1	-18.3	
11				4.8	-47.1	2.1	2.5	
12				9.5	-17.6	-0.5	-5.8	
13				14.3	217.6	-0.5	48.3	
14				0.0	170.6	-0.5	31.7	
15				4.8	141.2	-0.5	-14.2	
16				14.3	11.8	-0.5	10.8	
17				9.5	58.8	-0.5	23.3	
18				4.8	158.8	-0.5	15.0	
19				9.5	-217.6	2.1	2.5	
20				0.0	-158.8	-0.5	-10.0	
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Reviewer
Daniel Spicuzza

Date: 9/3/2009

Time: 0905

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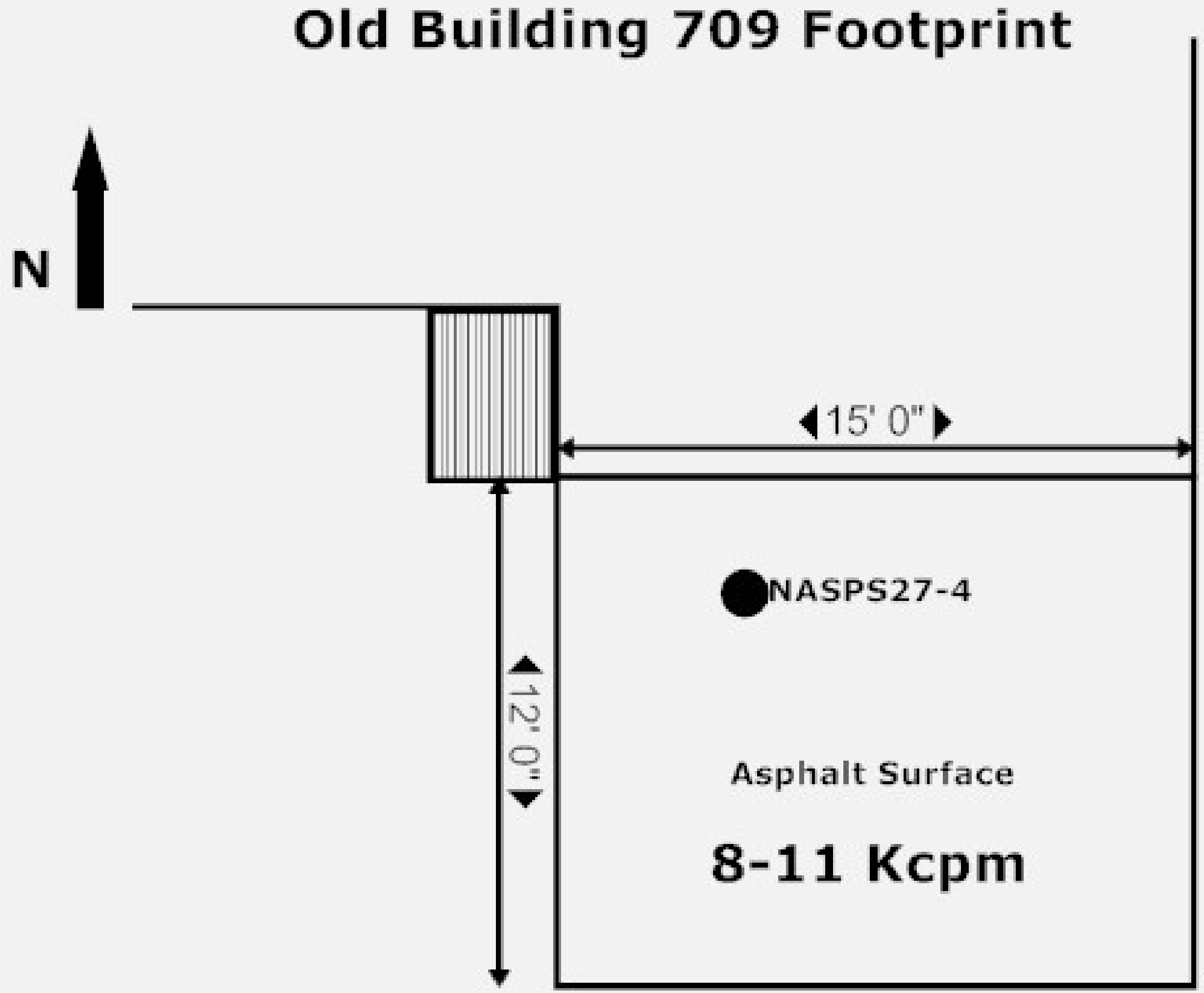
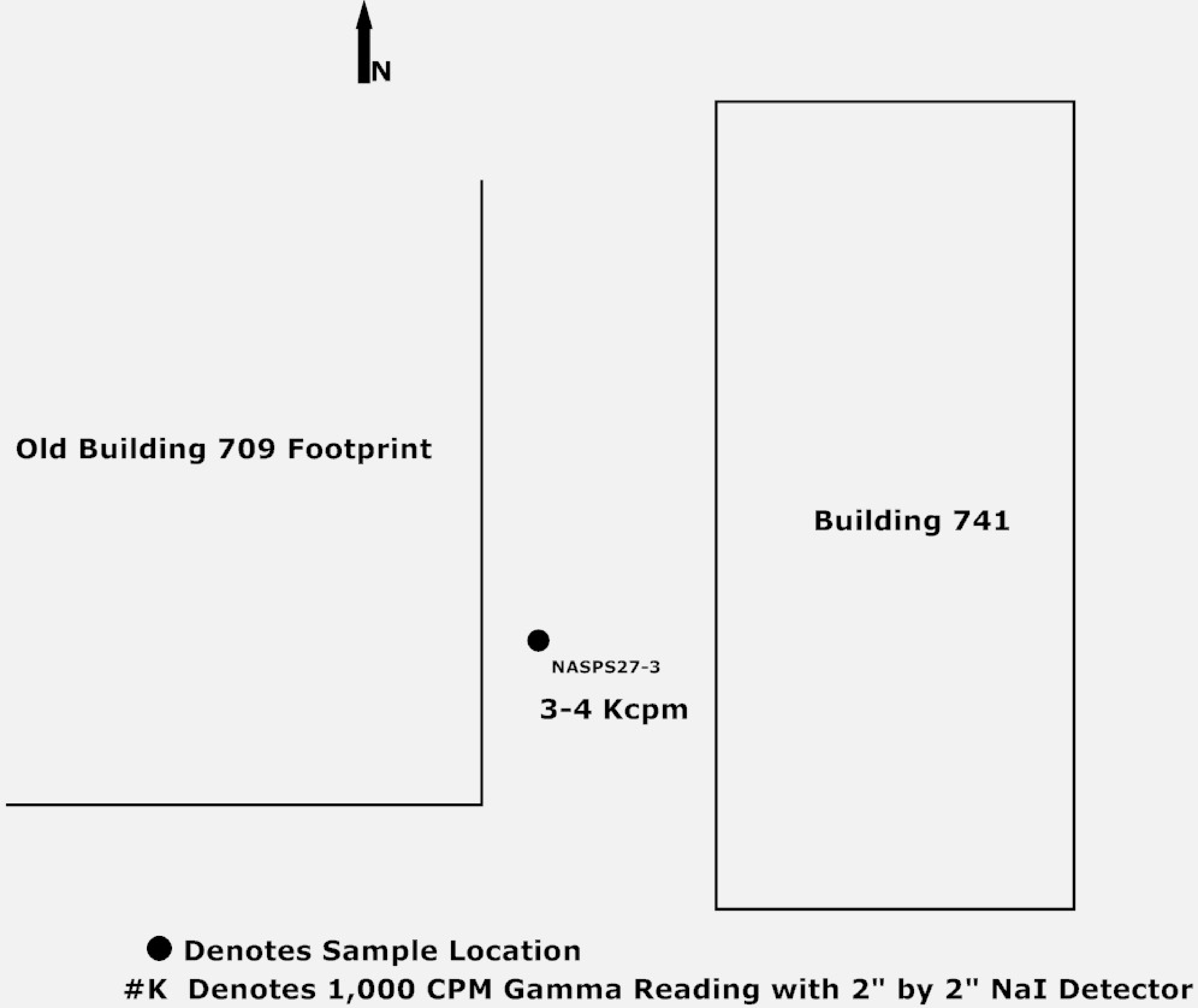
Attachment 4

Second Scoping Survey Effort Site 27 Data

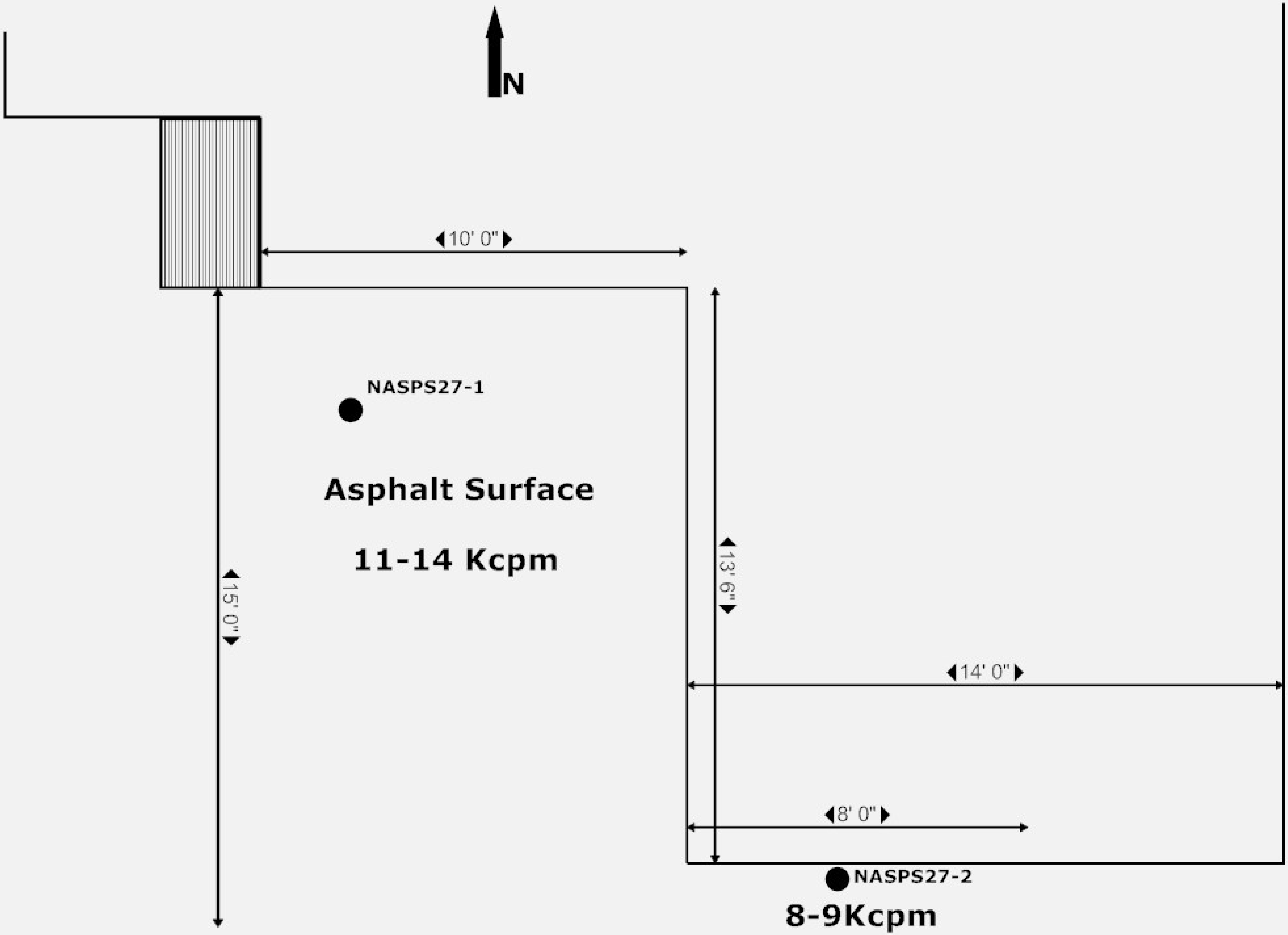


● Denotes Sample Location

#K Denotes 1,000 CPM Gamma Reading with 2" by 2" NaI Detector


N
Old Building 709 Footprint
Building 741
NASPS27-3
3-4 Kcpm
Denotes Sample Location
#K Denotes 1,000 CPM Gamma Reading with 2" by 2" NaI Detector

Old Building 709 Footprint



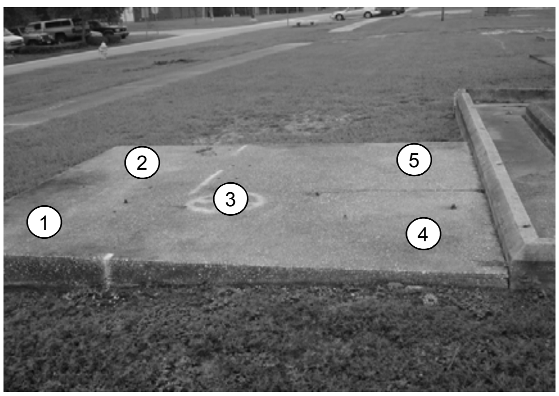
● Denotes Sample Location

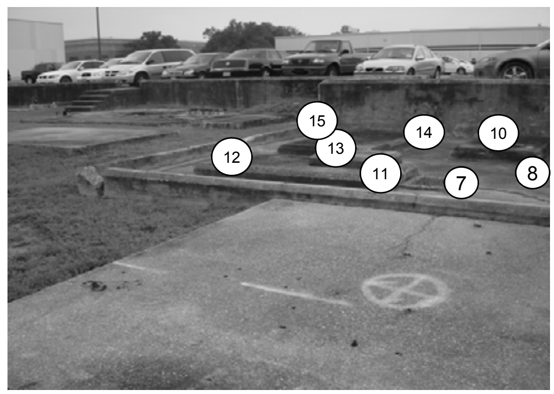
#K Denotes 1,000 CPM Gamma Reading with 2" by 2" NaI Detector

RADIATION/CONTAMINATION SURVEY FORM   Page 1 of 2

	INSTRUMENTATION USED						
DATE: TIME: 8/27/2009 14:55	Model Inst/Det.	Serial Number	Calibration Due Date	Instrument % Efficiency	Total % Efficiency	MDC/MDA + (dpm/100cm²)	Background + (dpm/100cm²)
	2360	156371	5/28/2010	α 43.00%	α 10.75%	α 82.35	α 46.51
SURVEY NUMBER: N/A	43-93	268606		βγ 34.00%	βγ 8.50%	βγ 566.07	βγ 2364.71
	N/A	N/A	N/A	α N/A	α #VALUE!	α #VALUE!	α #VALUE!
LOCATION: NAS Pensacola				βγ N/A	βγ #VALUE!	βγ #VALUE!	βγ #VALUE!
SURVEYOR: James Young							
DATE: TIME: 9/3/2009 1120							
Reviewed By: Daniel Spicuzza							
Isotopes of Concern: ^{226}Ra	Static Count Time: 2 Minutes						

Description of drawing: Old Building 709 Outside Southern Perimeter Concrete Pads





Comments:

Routine (Daily / Weekly / Monthly) ☐   Non-routine X

(#)	denotes swipe location and fixed α/β readings
#	denotes G/A radiation readings
# / #	denotes contact / 1 meter radiation readings.
*	denotes highest radiation reading on contact
LAW	denotes large area masslinn wipe
Δ	denotes static location.
K	denotes 1,000 cpm gamma
	All readings in μr/hr unless otherwise noted
☆	denotes solid sample location

RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER: N/A

SURVEYOR: James Young | LOCATION: NAS Pensacola

Location	Exposure Rate (µR/hr)		Fixed + Removable (NET)			Removable (NET)		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/Gamma dpm/100cm^2	
1				41.9	-252.9			
2				18.6	-311.8			
3				55.8	3105.9			
4				88.4	-135.3			
5				37.2	-76.5			
6				32.6	100.0			
7				9.3	-117.6			
8				14.0	-141.2			
9				-4.7	-147.1			
10				41.9	147.1			
11				409.3	1152.9			
12				46.5	335.3			
13				51.2	411.8			
14				437.2	1035.3			
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Reviewer	Date: 9/3/2009	
Daniel Spicuzza	Time: 1120	

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