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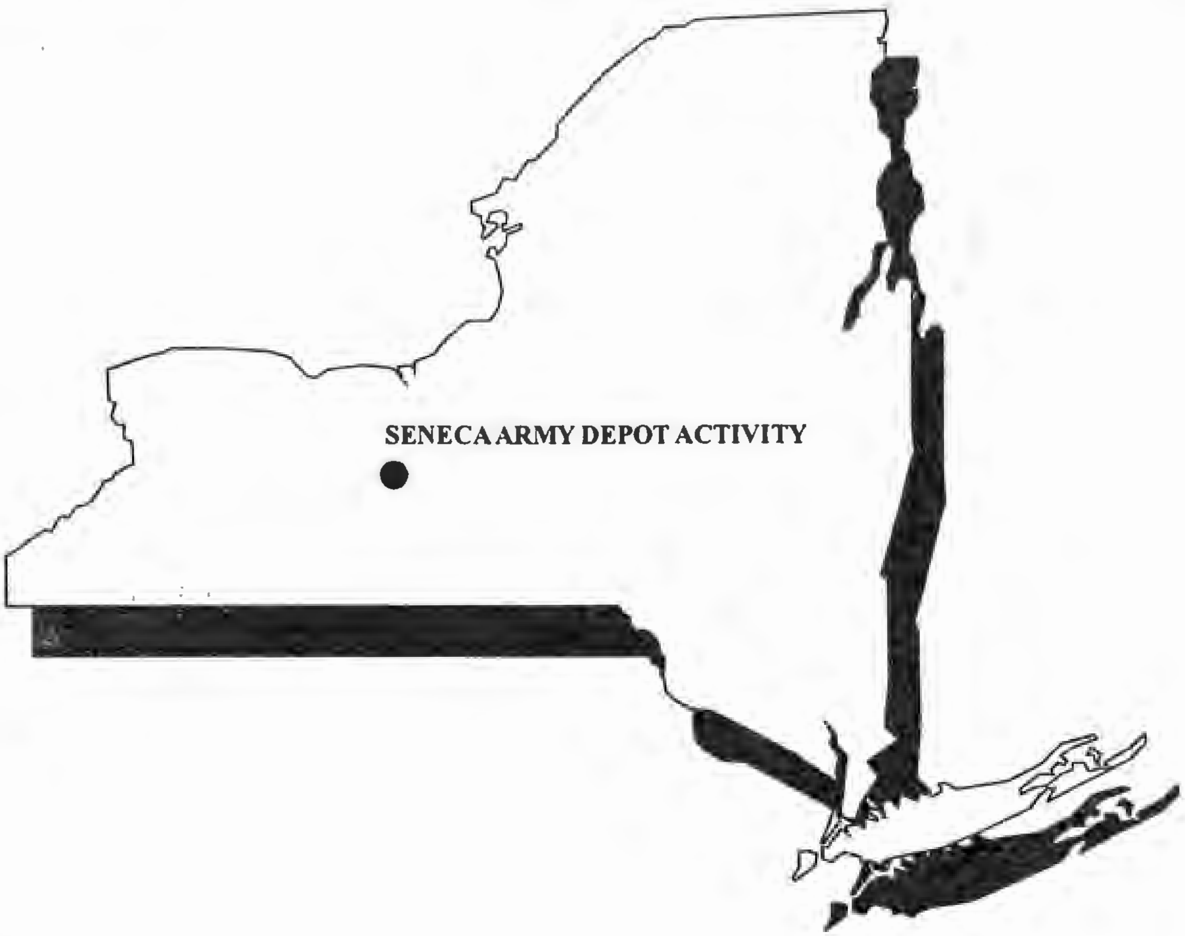

FINAL

E0800 ROW PITCHBLENDE ORE STORAGE IGLOOS (SEAD-48) WORK PLAN

CONTRACT NO. DACA87-95-D-0031
DELIVERY ORDER NO. 0028

NOVEMBER 2002

PARSONS

FINAL
WORK PLAN
E0800 ROW PITCHBLENDE ORE STORAGE IGLOOS (SEAD-48)
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

Prepared For:

Seneca Army Depot Activity
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Contract DACA87-95-D-0031
740497 - Delivery Order 28

NOVEMBER 2002

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LIST OF ACRONYMS

Ac	Actinium
AEC	Atomic Energy Commission
AEHA	Army Environmental Hygiene Agency
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute, Inc.
AOC	Areas of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
BRAC	Base Realignment and Closure
BRDC	U. S. Army Belvoir Research & Development Center
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Ci	Curie
cm	Centimeters
cm/sec	Centimeters per second
cpm	counts per minute
DCGL	Derived Concentration Guideline Level
DOA	Department of the Army
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
dpm	Disintegrations Per Minute
dps	Disintegrations Per Second
DQO	Data Quality Objective
EM	Electromagnetic
EMC	Elevated Measurement Comparison
EPA	Environmental Protection Agency
ESI	Expanded Site Inspections
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FB&DU	Ford Bacon & Davis Utah
FS	Feasibility Study
FSS	Final Status Survey
ft	Feet
ft/sec	Feet per second

H3	Tritium
HAZWOPPER	Hazardous Waste Operations and Emergency Response
HP	Health Physicist
HSA	Historic Site Assessment
IAG	Interagency Agreement
MARSSIM	Multi-Agency Radiological Survey and Site Investigation Manual
MCA	Multi Channel Analyzer
MDA	Minimum Detection Amount
MDC	Minimum Detectable Concentration
MED	Manhattan Engineer District
mg/l	Milligram per liter
mg/kg	Milligrams per kilogram
mL	Milliliter
mrem	milli-Roentgen equivalent man
mR	Milli-Roentgen
MSL	Mean Sea level
MW	Monitoring Well
NA	Not analyzed or not available
NaI	Sodium Iodide
NIST	National Institute of Standards and Technology
NBS	National Bureau of Standards
NCRP	National Council on Radiation Protection and Measurements
NPL	National Priority List
NRC	Nuclear Regulatory Commission
NUREG/CR	Stands for a series of NRC formal reports
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOL	New York State Department of Labor
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
Pa	Protactinium
Pb	Lead
PIC	Pressure Ionization Chambers

QA/QC	Quality Assurance/ Quality Control
R&D	Research and Development
Ra	Radium
RADCON	Radiation Decontamination
Rn	Radon
RSO	Radiation Safety Officer
SEDA	Seneca Army Depot Activity
SEAD	Seneca Army Depot Activity
TAGM	New York State Technical and Administrative Guidance Memorandum
Th	Thorium
U	Uranium
uR	Micro Roentgen
URSA	Universal Radiation Spectrum Analyzer
USACOE	United States Army Core of Engineers
WRS	Wilcoxon Rank Sum

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

Parsons is submitting this Work Plan, Delivery Order No. 28 under contract number DACA87-95-D-0031, for performing a Final Status Survey at the 800 row storage igloos (SEAD-48) that is located at the Seneca Army Depot Activity (SEDA) in Romulus, New York. A Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) based survey is required in order to investigate and close out this site. The Army is also responsible for investigating two of these igloos on a policy addressing radiological surveys of Base Realignment and Closure (BRAC) sites where radioactive commodities were stored (U.S. AMC, April 1998).

SEAD-48, which is an area consisting of eleven storage igloos, has been identified as a site that historically stored pitchblende ore from the Manhattan Project in the 1940's (M. Funkhouser, August 1985). Some of the bunkers were used to store the 1,823 barrels of high-grade pitchblende ore for a short time. Several assessments and surveys of the site have been performed in the past to determine levels of residual radioactivity and to decontaminate the site (**Section 1.3**).

The scope of work described in this work plan will be performed in accordance with the MARSSIM classification system to determine the status of each igloo based on the previous investigations and historical information. Once the bunkers are clearly classified, the Final Status Survey can be properly addressed. The procedure for this action is also included in this scope of work.

The work proposed in this report will be performed as part of the United States Army Corps of Engineers (USACOE) remedial response activities under CERCLA. It will follow the requirements of the New York State Department of Environmental Conservation (NYSDEC), the U.S. Environmental Protection Agency, Region II (EPA), and the Interagency Agreement (IAG).

The overall site conditions and site history, along with descriptions of the historical surveys that have been performed at SEAD-48 and a review of that information are presented in **Section 1.0** of this report. **Section 2.0** presents the MARSSIM classifications of each igloo and a justification for the classification. A design for performing a Final Status Survey is presented in **Section 3.0**. This includes sampling methods and procedures, field screening, visual inspections and laboratory analysis. The remaining sections discuss data assessment and reporting, staffing, and scheduling.

1.2 BACKGROUND

1.2.1 Site Description

Seneca Army Depot Activity (SEDA) is located about 40 miles south of Lake Ontario, near Romulus, Seneca County, New York (**Figure 1-1**). Seneca County is located in the center of the state, in the heart of the Finger Lakes Region. The facility is located in an uplands area, at an elevation of approximately 600 feet Mean Sea Level (MSL) that forms a divide separating two of the Finger Lakes; Cayuga Lake on the east and Seneca Lake on the west. New York State Highways 96 and 96A adjoin SEDA on the east and west boundaries, respectively. The surrounding area is sparsely populated farmland.

The 10,587-acre SEDA facility was constructed in 1941 and has been owned by the U.S. government and operated by the Department of the Army (DOA) since that date. From its inception in 1941 until 1995, SEDA's primary mission was the receipt, storage, maintenance, and supply of military items, including munitions and equipment. The Depot's mission changed in 1995 when the Department of Defense (DOD) recommended closure of the SEDA under its Base Realignment and Closure (BRAC) process.

1.2.2 Site History

SEAD-48, which is located in the southern area of SEDA (**Figure 1-2**), consists of 11 ammunition storage bunkers (igloos), E0801 though E0811, that once stored approximately 2,000 barrels of pitchblende ore in the 1940's (**Figure 1-3**). Upon removal of the pitchblende ore, the igloos then became a storage site for non-radioactive army munitions until the late 1970's. Expanded site investigations at this site in 1976 and in 1980 and again in 1985 indicated that Ra-226, U-234, U-235 and U-238 in the soil may present risks to human health and to the environment (U.S Army Belvoir Research Group, June 1985; FB&DU, November 1981; U.S. Army Ballistic Research Laboratory, January, 1986). The bunkers were surveyed and remediated in the mid 1980's to allow unrestricted use per the U.S. Nuclear Regulatory Commission (NRC). Igloos E0801 and E0802 are included in a license termination plan for the U.S. Army. The NRC termination activity involves the review of all previously released facilities to ensure compliance with current NRC standards (ANL, January 2002). Subsequent investigation conducted in 1993 by the NYSDOH indicated that areas within SEAD-48 may still have elevated levels of radioactive contamination (NYSDOH, September 1993). Summaries of the work preformed at the site are included in **Section 1.3** of this report, and **Appendix A**.

The igloos are located within the secured area along Igloo Road No. 39. Each igloo is constructed with reinforced concrete and measures 26.8 feet wide by 81 feet long by 13 ft high (**Figure 1-4**). On the inside, each igloo has one roof vent and two drainage openings at ground level, one in the northeast corner and one in the northwest corner of each igloo. There are interior troughs that drain to the drainage openings. The bunkers, on the outside, are covered with a minimum of 2 feet of soil material with extensive growth of grasses, weeds and small shrubs. At the north end of each igloo, outside the door to the bunker, is a concrete pad. An asphalt apron exists from the concrete pad to the road. The remaining area surrounding the igloos is field grass (**Figure 1-5**).

The topography in the area of SEAD-48 slopes generally to the west. Surface water flow from precipitation events in this area is controlled by local topography and the drainage ditches that lie along Igloo Road No. 39. In each of these drainage pathways, the surface water flow is eventually to Silver Creek or Indian Creek. The groundwater flow directions are generally perpendicular to the ground surface contours. In the eastern portion of SEAD-48, groundwater would be expected to flow towards Silver Creek. For those areas that are west of Igloo E0806, groundwater would be expected to flow towards the west, following the surface topography of the site.

Till, weathered gray shale, and competent gray shale are the three major geologic units expected to be present at SEAD-48. Topsoil is likely to be present throughout the site with thicknesses ranging from 1.0 to 1.5 feet. The till at SEDA is typically characterized as brown or olive gray silt and very fine sand with small (less than 1 inch) fragments of shale. Clay lenses are observed occasionally. Larger shale fragments, thought to be rip-up clasts, are encountered throughout SEDA. The depths to the bottom of the till at SEAD-48 are likely to be between 4 and 10 feet. The weathered shale that forms the transition between till and competent shale has been observed in all of the soil borings performed at SEDA during the ESIs and RIs. The thicknesses have ranged from approximately one foot to over 20 feet. Competent gray shale has been observed in many of the soil borings at SEDA. The reported depths to bedrock have ranged from 4.5 to over 30 feet below ground surface.

Determination of the local site geology is based on a review of the document "Proposed Action: Pitchblende Reside Remedial Action Project" (SEDA, 1985) and a common understanding of the till geology of SEDA acquired during the drilling and test pitting programs conducted in the various investigations at SEDA.

1.3 HISTORICAL SURVEYS

Several surveys have been conducted at SEAD-48 over the past 25 years. Information from these surveys is summarized below.

September 1976 DOE (ERDA) Survey and Follow up Survey in 1980: These surveys of igloos E0801 through E0811 were performed by Oak Ridge National Laboratory (ORNL) and Ford, Bacon & Davis Utah, Inc. (FB&DU). Alpha, beta, and gamma readings were collected both inside and around the igloos and in the soils and surface waters by the igloos. Levels of radon and its progenies were also measured inside the igloos. The results of the surveys indicated that residual contamination exceeding the occupational and environmental limits set at that time by the NRC and by the EPA existed. See **Table 1-1** for a summary of the initial survey completed by the DOE in 1976.

Residual contamination was found at eight of the eleven SEAD-48 igloos (E0804 – E0811). Results indicated that E0804 and E0806 were above NRC guidelines for surface contamination of U-235, U-238 and associated decay products (FB&DU, November 1981). Soil contamination was found that was located within several meters of the entrance of the bunkers. Results from the radon survey indicated that levels were elevated above background in bunkers E0804 to E0811 with the highest concentrations in bunkers E0804 and E0808. Neither team found significant levels of contamination at bunkers E0801 through E0803; these bunkers were considered relatively uncontaminated. (FB&DU, 1981 and U.S Army Belvoir R&D Center, 1985).

Based on the survey results, recommendations were made to decontaminate the affected igloos and soils (FB & DU, 1981).

May 1985 Army RADCON Survey: At the request of the Seneca Safety Office, radiological surveys were performed by two RADCON teams at igloos E0801 through E0811. The survey measured the following:

1) Direct alpha and beta surface contamination;
2) Removable alpha and beta contamination;
3) Interior and exterior gamma radiation levels;
4) Uranium levels in soil and water in the vicinity of the bunkers;
5) Air monitoring for radon and radon progeny; and
6) Activity levels along the rail spur and loading dock used to transport the ore.

The instrumentation used to perform the surveys consisted of:

- Ludlum 2220 FIDLER for low-energy gamma detection;
- Ludlum Model 3 Pancake G-M meter for beta and low-energy gamma detection;
- Ludlum Model 19 microR meter for high-energy gamma (exposure rates);
- PAC-1SA gas proportional counter for alpha particle detection; and
- Canberra 2401 or Eberline Models AC-4 and BC-4 for counting removable alpha and beta particles on smears, respectively.

The first RADCON team performed systematic surveys of bunker interiors and on the pad directly in front of the entrance to each igloo. The interior survey was performed along five survey lines running across the bunkers starting one meter from the back wall and spaced 6 meters apart. Continuous scans were taken along the lines with the FIDLER and microR meters. Four direct readings, two from floor and two from the wall/ceiling, were also recorded using the FIDLER, Model 3, PAC 1SA, and microR instruments along these lines. Smears were taken at the same locations. The spaces between the 6-meter survey lines were scanned at 2-meter intervals using the FIDLER and microR meter. The second RADCON team completed a similar survey using the same instruments, but collecting measurements along different lines. The two surveys were completed in succession.

The NRC guidelines for unrestricted use that were used set the acceptable levels of contamination of natural uranium and its associated decay products at the following levels:

- 5000 dpm/100cm^2 for average fixed alpha;
- 15,000 dpm/100cm^2 for maximum fixed alpha;
- 1000 dpm/100cm^2 for removable alpha;
- 1000 dpm/100cm^2 for removable beta;
- 0.2 mrad/hr for average beta-gamma dose at 1 cm above the surface; and
- 1.0 mrad/hr for maximum beta-gamma dose at 1 cm above surface.

Using these levels for criteria, there were instances in igloos E0804 and E0806 where the direct reading measuring fixed alpha exceed 5000 dpm/100cm^2. There were no levels above 1000 dpm/100cm^2 measured for removable alpha or beta. In igloo E0804 dose rates above 1.0 mrad/ hour were detected (**Table 1-2**). It was concluded that contamination of natural uranium and its progeny existed on the interior surfaces of igloos E0804 through E0811, (**Table 1-2**). The concrete pad at the entrance was also found to have contamination levels in excess of the NRC guidance (**Table 1-2**).

Based on the germanium gamma spectrometry analysis of debris collected from interior drains, some degree of activity of U-238 and Ra-226 existed in all bunkers except E0801, E0802 and E0808 (**Table 1-3**). From soil samples collected outside the igloos, elevated levels of U-238 and Ra-226 were present at igloos E0804, E0805, E0806, E0808, E0809, E0810, and E0811. The highest levels were documented at igloo E0804. Exposure rates at igloo E0804 ranged as high as 1033 uR/hr, while soil samples had concentrations as high as 2400 pCi/g U-238 and 1590 pCi/g Ra-226. Surveys of the railway spur and the loading area showed no elevated activity.

Recommendations were made to decontaminate areas within igloo E0804 that exceed 5000 dpm/100cm^2 by methods such as sandblasting and grinding. It was additionally proposed to remove soils to a depth of 6 inches at igloos E0804 and E0811 (U.S. Army Ballistic Research Laboratory, January 1986).

June 1985 On-Site Lab Setup and Bunker Survey: A portable environmental radiation survey laboratory was set up at SEDA with the purpose of supporting a radiation decontamination activity at igloos 2047, 2049, 2051, 2053, 2055, 2057, 2059, 2061, 2063, and 2065. It is believed that the above named igloos are the same as igloos E0802 though E0811, respectively. Belvoir R&D Center (BRDC) and SEDA personnel were responsible for the assembly of the lab and of the execution of the survey.

Two Reuter-Stokes RSS-111 pressurized ionization chambers (PICs), a Canberra Series 10 germanium detector/MCA, and a Ludlum 19 were employed. Clean soil from the site was tested against BRDC soil standards (NBS, now NIST, traceable). Background exposure rate measurements taken in Building 321 using the PICs averaged 8.3 uR/hr.

The survey reported that all interior exposure rate readings were in the range of 7-11 uR/hr. This was similar to background and well below the EPA standard of 20 uR/hr over background (US Army Belvoir R&D Center, July 1985). Exterior measurements made within 3 meters of the entrance at 1 -meter height ranged from 57 uR/hr to 4,000 uR/hr. The highest values were outside bunker 2051 (Igloo E0804) (U.S Army Belvoir R & D Center, July 1985).

July 1985 SEDA Decontamination Activity: Workers decontaminated igloos by scraping, abrading, and vacuum blasting the floors, gutters, and interior surfaces of the bunkers using chisels, shovels, jackhammers, and a backhoe. Post-decontamination, over 300 radiological samples were collected and over 90 tons of soil, asphalt and concrete were removed from the interiors and exteriors of the SEAD-48 igloos.

Continuous field surveys were performed to map contamination during removal. The 300 samples, collected from in soil, air filters, nasal wipes, airhats, shipping containers, and equipment, were analyzed for U-238 and Ra-226. Thirty-six soil samples were collected and showed levels of U^{238} and Ra-226 below the radiological standard of 5 pCi/g. There were 120 samples taken from the thirty B25 shipping containers that were filled; reported levels of the samples were less than 22 dpm/100 cm^2, in accordance with 49 CFR standard (U.S. Army Belvoir R&D Center, 1985).

July 1985 U.S. Army Industrial Hygiene Agency (AEHA) Closeout Survey: The AEHA surveyed SEAD-48 to determine the success of the radiological decontamination activity that the Army had performed earlier in the month. The survey evaluated if radioactive contamination still existed within the bunkers and the surrounding area, and if so, the extent of the remaining contamination.

Results from the interior survey indicated that the highest gamma reading of 15uR/hr was found in Igloos 804 and 805; 10uR/hr was determined to be the background level for gamma. Gamma readings were taken approximately 1 meter from the floor. The highest beta reading was 400-500 cpm, which was in Igloo 804; the background level was determined to be 0-5 cpm for beta radiation. The highest alpha reading was 2,000 cpm, which was found in Igloo 808; the alpha background level was determined to be 0 cpm.

Results from the exterior survey indicated that the highest gamma reading was 150 uR/hr, which was outside Igloo 804; background gamma radiation was 10uR/hr. Alpha and beta readings were all at background levels, which was 0 cpm for both alpha and beta radiation.

Wipe samples were collected to evaluate if removable contamination existed. The highest gross beta count ($3.6 +/- 0.4 \times 10^{-5}$ uCi or 80 dpm/100cm^2) corresponded with the location that had the highest beta and gamma instrument reading. The highest alpha count ($2.1+/- 0.3 \times 10^{-5}$ uCi or 47 dpm/100cm^2) was located in Igloo 804. Most of the wipe samples were below the detection limit of the instrument.

Soil samples were collected to evaluate if elevated areas of radioactivity existed after the excavation of the soil from around the pads. The extent of the soil that was removed during the decontamination activity is approximated in **Figures 1-6** through **1-13** (U.S. Army, December 1985). The gamma activities were all below 15 pCi/g and considered to be at background levels.

The conclusions of the survey were that the eleven bunkers and the surrounding area were consistent with the requirements for unrestricted use and that SEAD-48 should not be considered a contaminated area.

October 1987 NRC Closeout Inspection: An inspection of SEAD-48 was completed to determine if the area should be released for unrestricted use. A visual inspection of the bunkers was completed, site personnel were interviewed, records were examined, and random radiological measurements were collected at the site.

Twenty-seven wipe samples were collected and analyzed for removable alpha/beta contamination; no removable radioactivity was detected. Two soil and one water sample were collected outside Igloo E0804 and analyzed using germanium gamma spectrometry; no elevated gamma radioactivity was detected. The gamma radiation levels, measured with a Micro-R meter, were found to be at background levels.

No violations were observed during the inspection. Igloos EO801 through EO811 were released for unrestricted use.

June 1993 NYSDEC Bureau of Radiation Protection (BERP) Survey: Radiological site surveys, including SEAD-48 and background igloo E0710, were conducted at SEDA by NYSDEC and NYSDOH. The purpose of the brief evaluation was to see if there was a possibility of residual radioactive contamination present. Instruments used in the survey were:

- a Ludlum microR to measure exposure rate;
- Ludlum Model 3-98 with internal G-M probe and external NaI probe to measure gamma radiation, and
- An Eberline E-120 G-M meter to measure beta radiation.

The survey conducted at SEAD-48 consisted of instrument readings at twelve locations at and around igloo E0804, two locations at and around E0806, one location at E0808 at both ends of the drain, two locations at and around E0809, and one location at the background igloo E0710. Three soil samples were collected from igloo E0804; one soil sample was collected from E0808; and one soil sample from E0710. Additionally, two wipes were collected at E0804 and one at E0806.

Results from the survey indicated that further remediation of radiological contamination was necessary at several areas inside and outside of igloo E0804 and at one hotspot inside of igloo E0808 in a drain. Contamination in E0804 was found along the interior drainage trough, in the outside drains on the north wall 1-2 feet above ground level, and in the soil around the drains. Readings inside E0804 ranged as high as 40 uR/hr and 400 cpm beta, compared to a background level of 4-15 uR/hr and 20-40 cpm beta in E0710. Soil near the east side of the north wall outside E0804 had readings up to 106 uR/hr and 18,000 cpm beta at a depth of 4-6 inches. A soil sample collected at the hotspot in E0808 was found to contain elevated levels of U-238, U-235, and Ra-226. The results were 83 pCi/g, 11 pCi/g, and 87 pCi/g, respectively. Readings from other SEAD-48 igloos did not deviate significantly from background (NYSDOH, September 1993).

Historical Surveys Review

Although there have been several radiological surveys completed at SEAD-48 and decontamination activities have taken place, these surveys would not meet the current MARSSIM guidance for unrestricted use of the area. The surveys do provide helpful information for site classification and for planning a final status survey of the area.

Historically igloos E0801 through E0803 have shown no evidence of residual elevated contamination. Igloos E0804 through E0811 have indicated in at least one instance that elevated radioactivity existed. There was a decontamination activity in 1985 where remediation was conducted inside the bunkers and around the entrance pads to the bunkers. The follow-up post-remediation surveys ultimately allowed for unrestricted release of the area. However, the surveys do indicate that elevated activity may remain in some of the igloos at levels that could exceed the present day standards. The brief survey performed by the NYSDEC in 1993 did not survey all eleven SEAD-48 igloos, but did provide some evidence that there may still be residual contamination present inside and around the igloos that require further investigation. All activities will be performed in accordance with the guidance of the current BRAC and MARSSIM standards.

PARSONS

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY

FINAL WORK PLAN
SEAD-48 (800 ROW STORAGE IGLOOS)

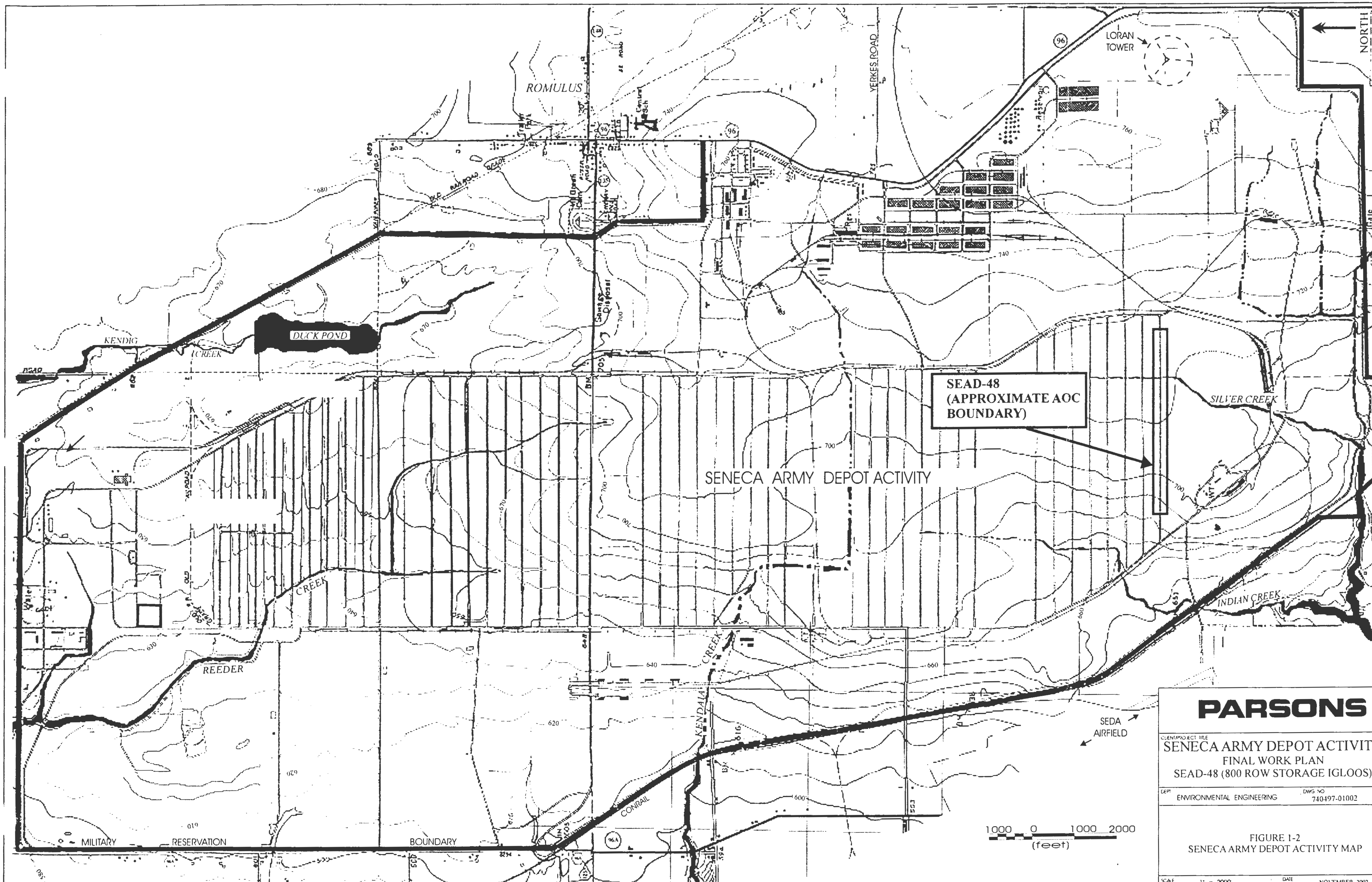
DEPT	DWG NO
ENVIRONMENTAL ENGINEERING	740497-01002

FIGURE 1-1

SENECA ARMY DEPOT ACTIVITY
LOCATION MAP

SCALE	DATE
1"= 8 MILES APPROX.	NOVEMBER 2002

P:\PIT\PROJECTS\SENECA SEAD-48\WORKPLAN\FINAL FIGURE1-1.CDR



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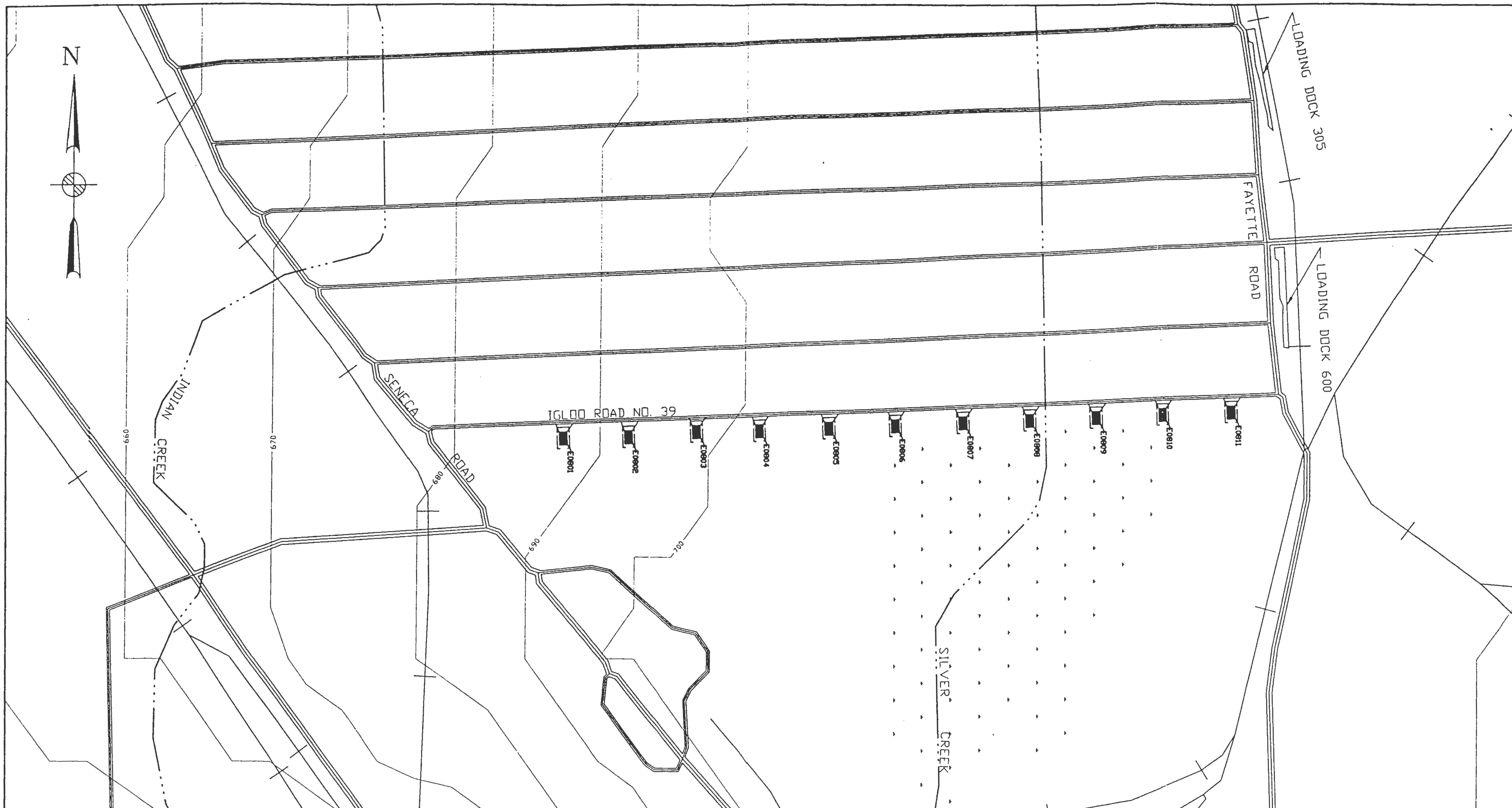
SENECA ARMY DEPOT ACTIVITY
FINAL WORK PLAN
SEAD-48 (800 ROW STORAGE IGLOOS)

ENVIRONMENTAL ENGINEERING | DWG NO 740497-01002

FIGURE 1-2
SENECA ARMY DEPOT ACTIVITY MAP

SCALE 1" = 2000 | DATE NOVEMBER 2002

P:\PIT\PROJECTS\SENECA\SEAD-48\WORKPLAN\FINAL\FIGURE 1-2.CDR



ACAD\SENECA\RIFS\SEAD48\SD48SI.DWG

LEGEND

MINOR WATERWAY
MAJOR WATERWAY
FENCE
UNPAVED ROAD
BRUSH LINE
LANDFILL EXTENT
RAILROAD
760 GROUND SURFACE ELEVATION CONTOUR
SURVEY MONUMENT
WETLANDS
ROAD SIGN
DECIDUOUS TREE
FIRE HYDRANT
MANHOLE
GUIDE POST
POLE
UTILITY BOX
COORDINATE GRID (250' GRID)
OVERHEAD UTILITY POLE
MAILBOX/RR SIGNAL

300 0 300 600
1" = 600'

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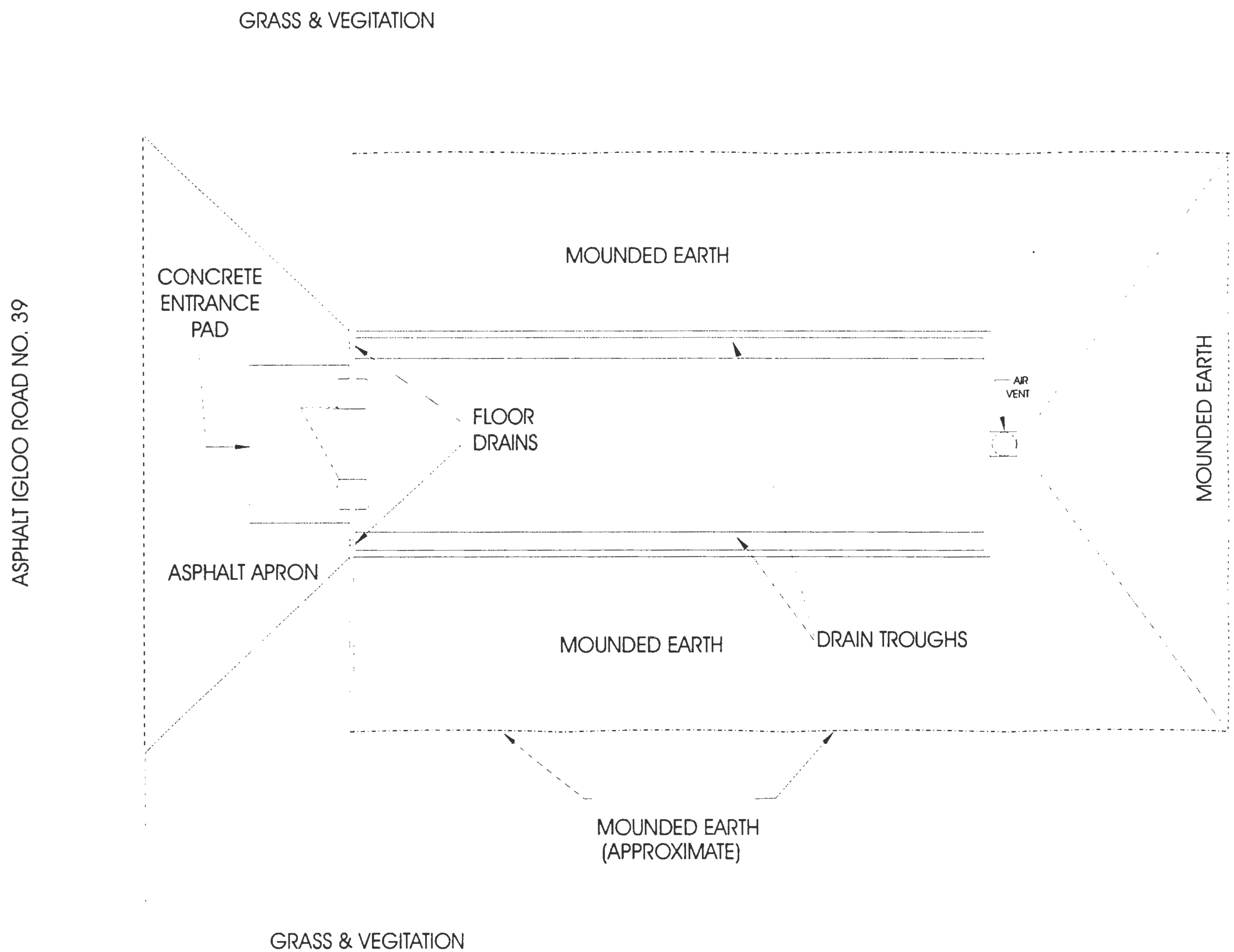
CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
FINAL WORK PLAN
SEAD-48 (800 ROW STORAGE IGLOOS)

DEPT ENVIRONMENTAL ENGINEERING
Dwg No 740497-01002

FIGURE 1-3
SITE PLAN

SCALE 1" = 600'
DATE NOVEMBER 2002
REV



NOTES:
-THE APPROXIMATE DIMENSIONS OF THE SEAD-48 IGLOOS ARE 81 FEET IN LENGTH BY 26.8 FEET IN WIDTH.

PARSONS

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
FINAL WORKPLAN
SEAD-48 (800 ROW STORAGE IGLOOS)

DEPT	DWG NO
ENVIRONMENTAL ENGINEERING	740497-01002

FIGURE 1-4
SCHEMATIC DRAWING OF TYPICAL IGLOO STRUCTURE

SCALE 1 INCH = 20 FEET DATE NOVEMBER 2002

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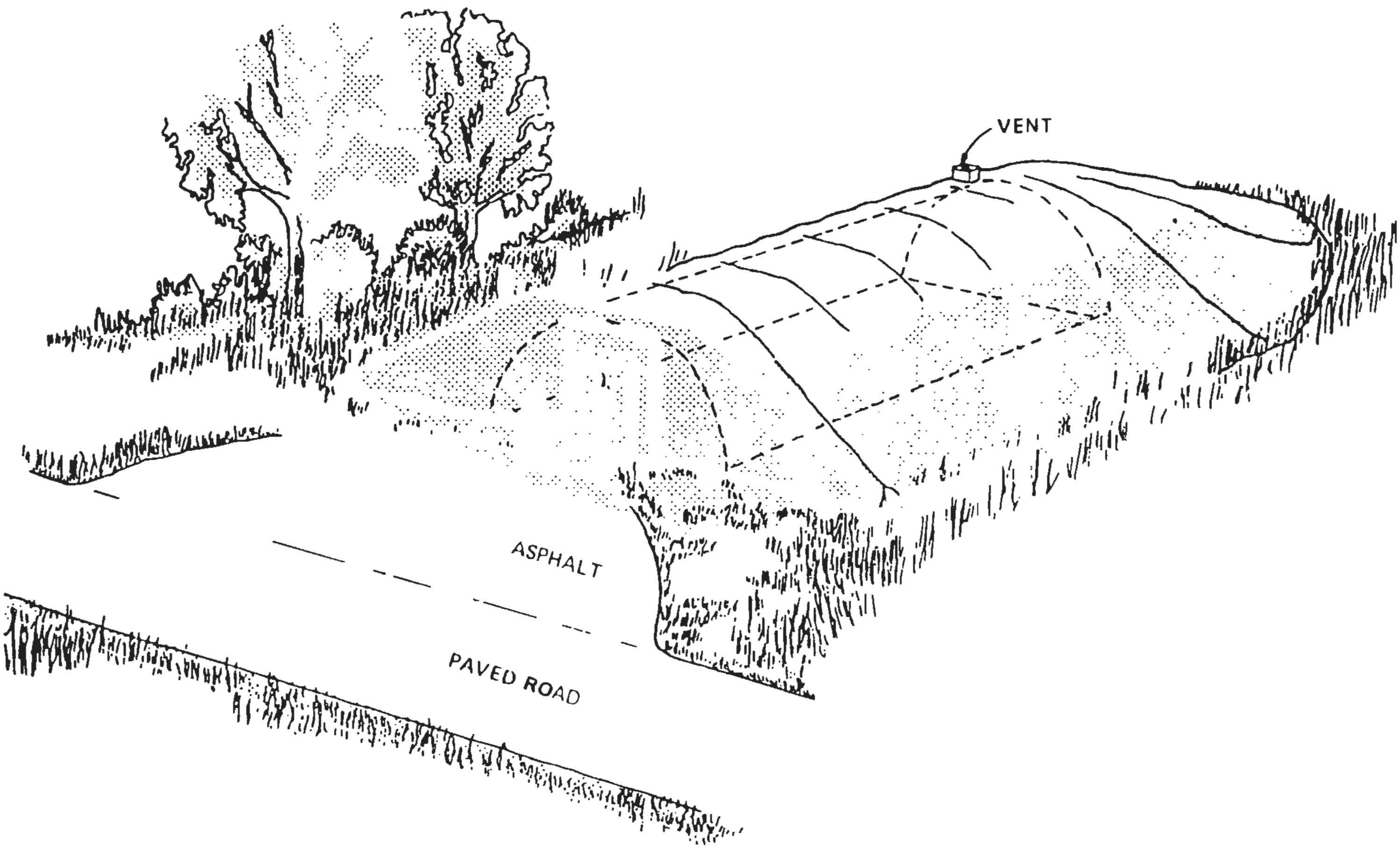
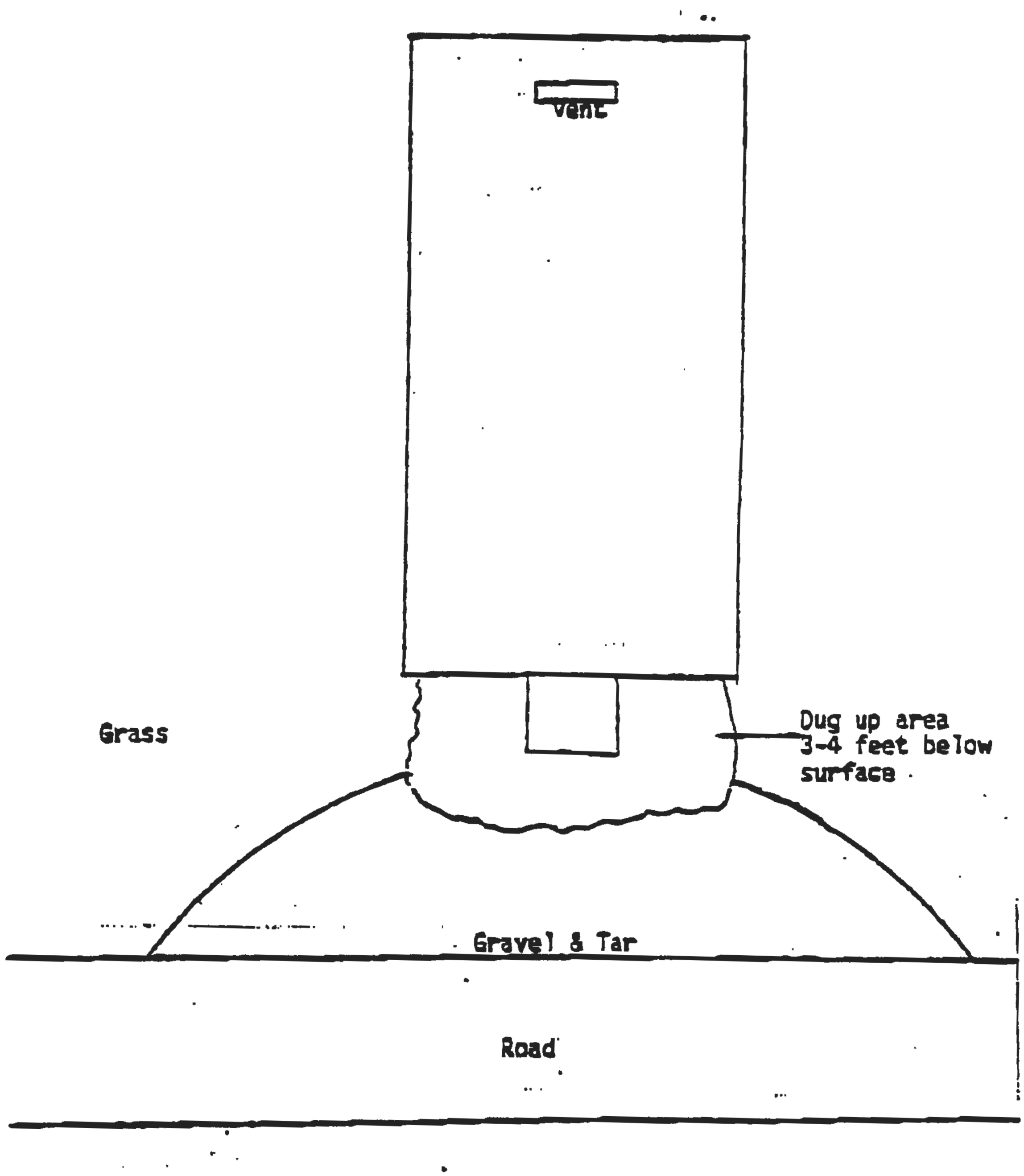
Figure 1-5
Typical Bunker Configuration
SEAD-48 Work Plan
Seneca Army Depot Activity



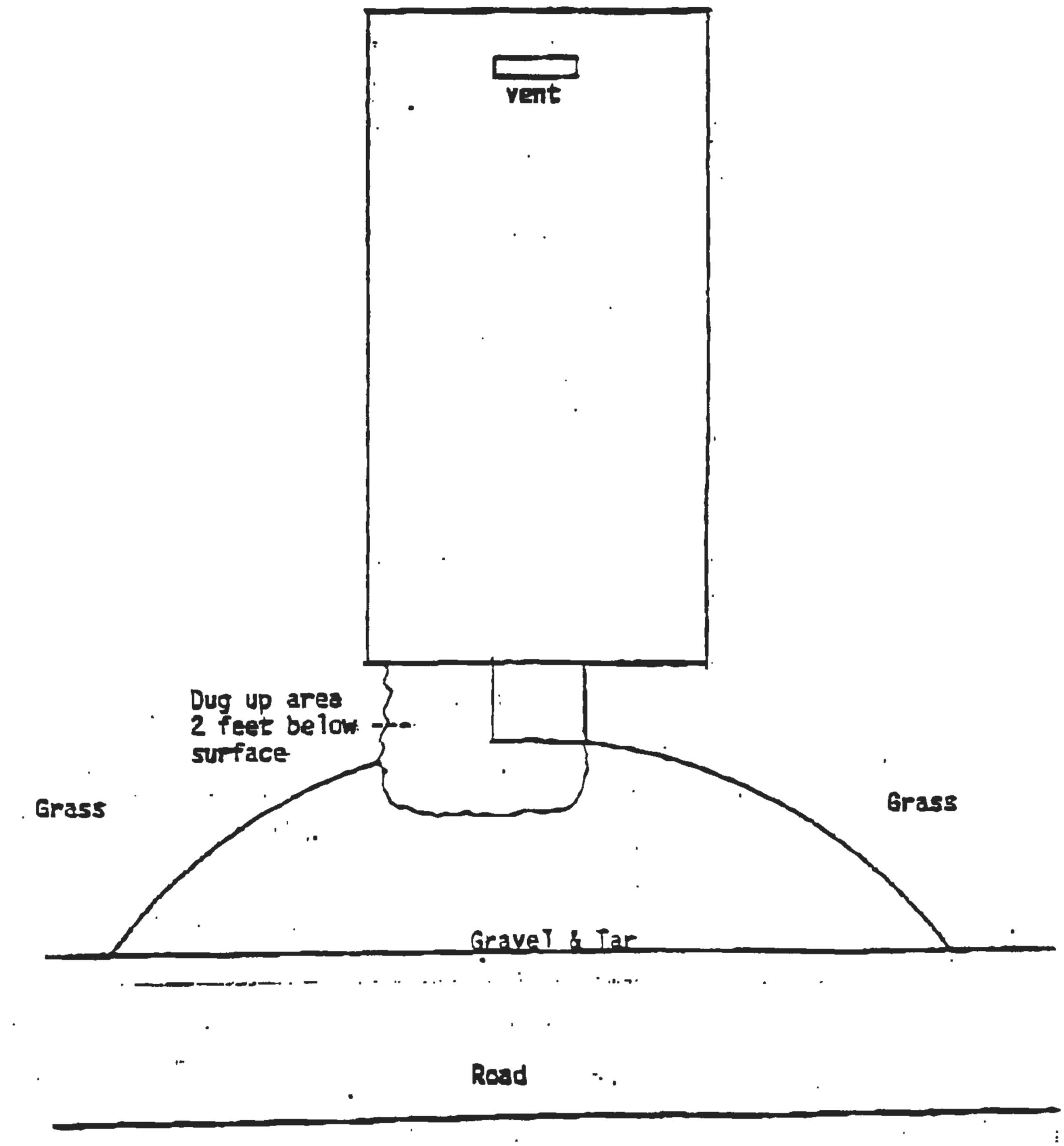
Note: This figure was taken from the Preliminary Engineering and Environmental Evaluation of the Remedial Action Alternatives For the Seneca Army Depot Site, Ford, Bacon & Davis Utah, November 1981.

Figure 1-6
The Approximate Extent of Excavation Activities at Igloo E0804
SEAD-48 Work Plan
Seneca Army Depot Activity



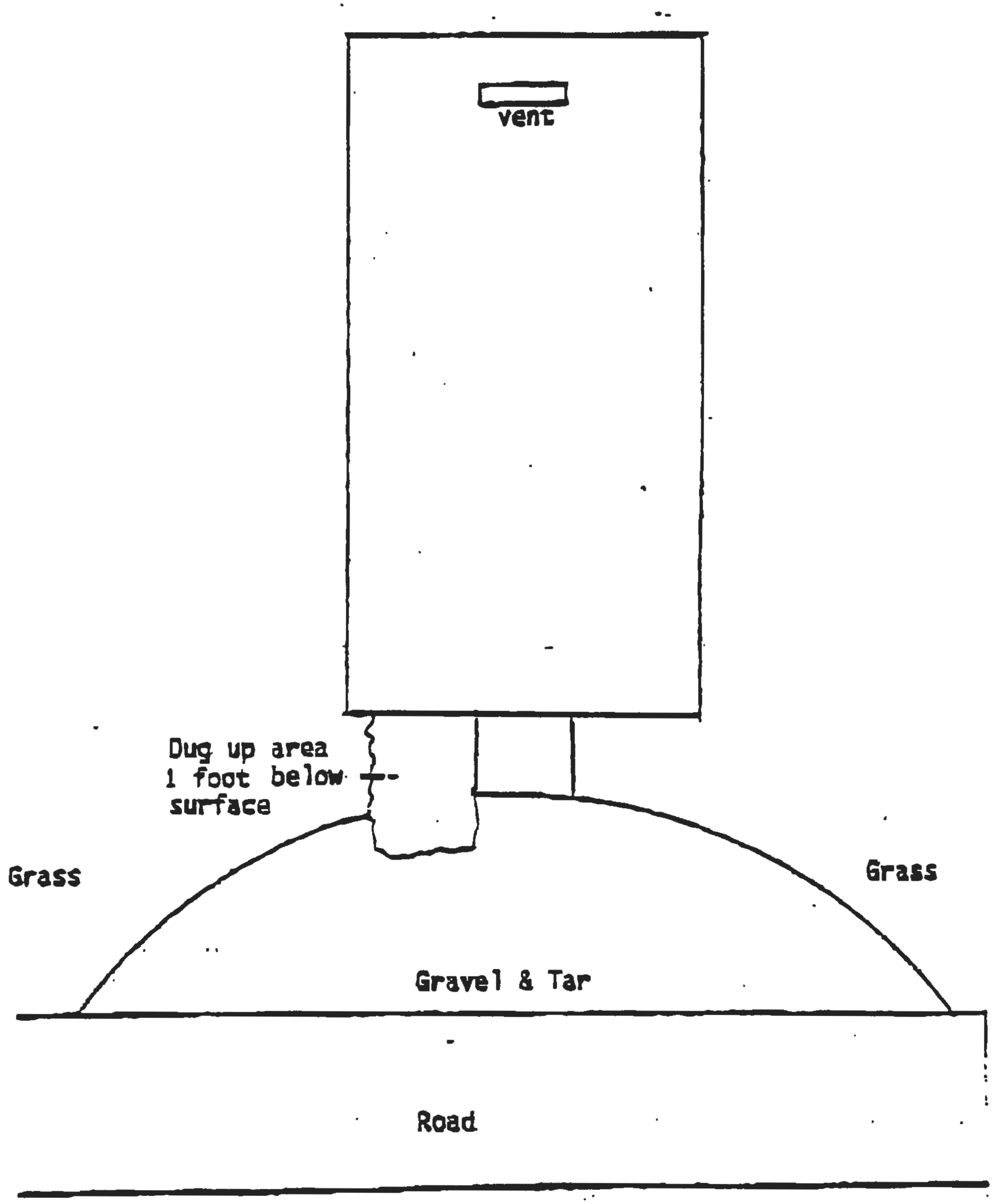
Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985. The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

Figure 1-7
The Approximate Extent of Excavation Activities at Igloo E0805
SEAD-48 Work Plan
Seneca Army Depot Activity



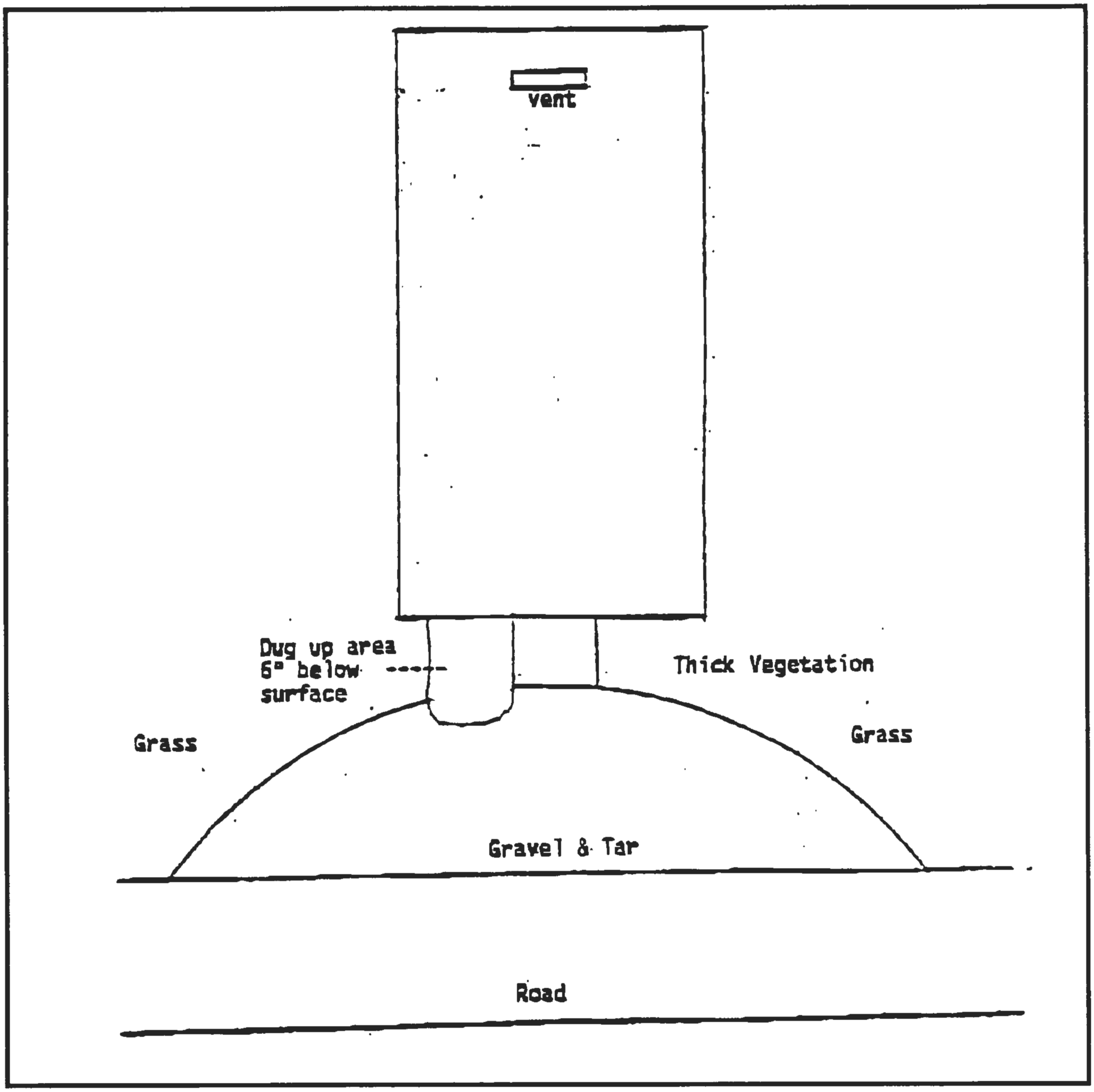
Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985. The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

Figure 1-8
The Approximate Extent of Excavation Activities at E0806
SEAD-48 Work Plan
Seneca Army Depot Activity



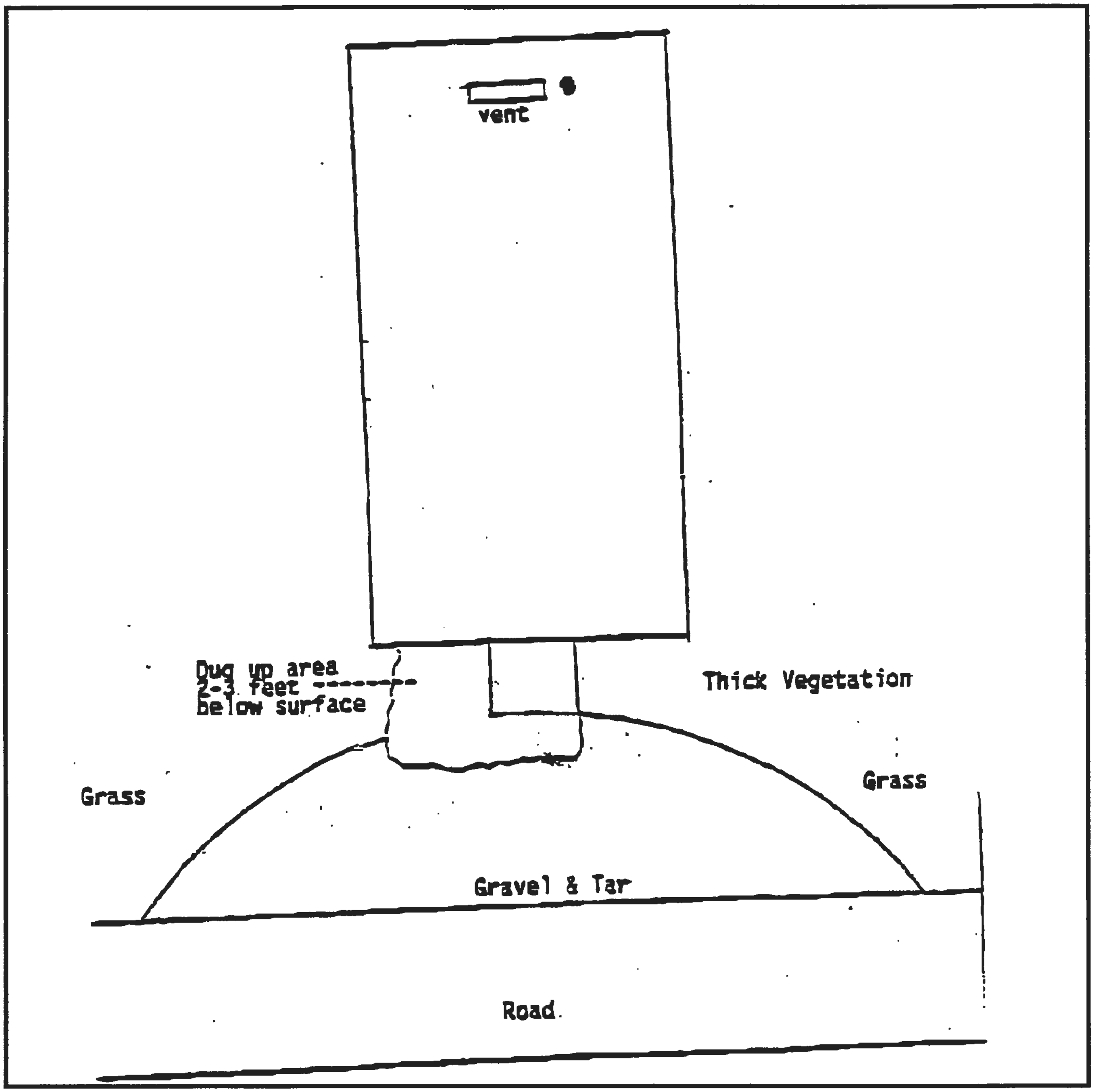
Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985.
The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

Figure 1-9
The Approximate Extent of Excavation Activities at E0807
SEAD-48 Work Plan
Seneca Army Depot Activity



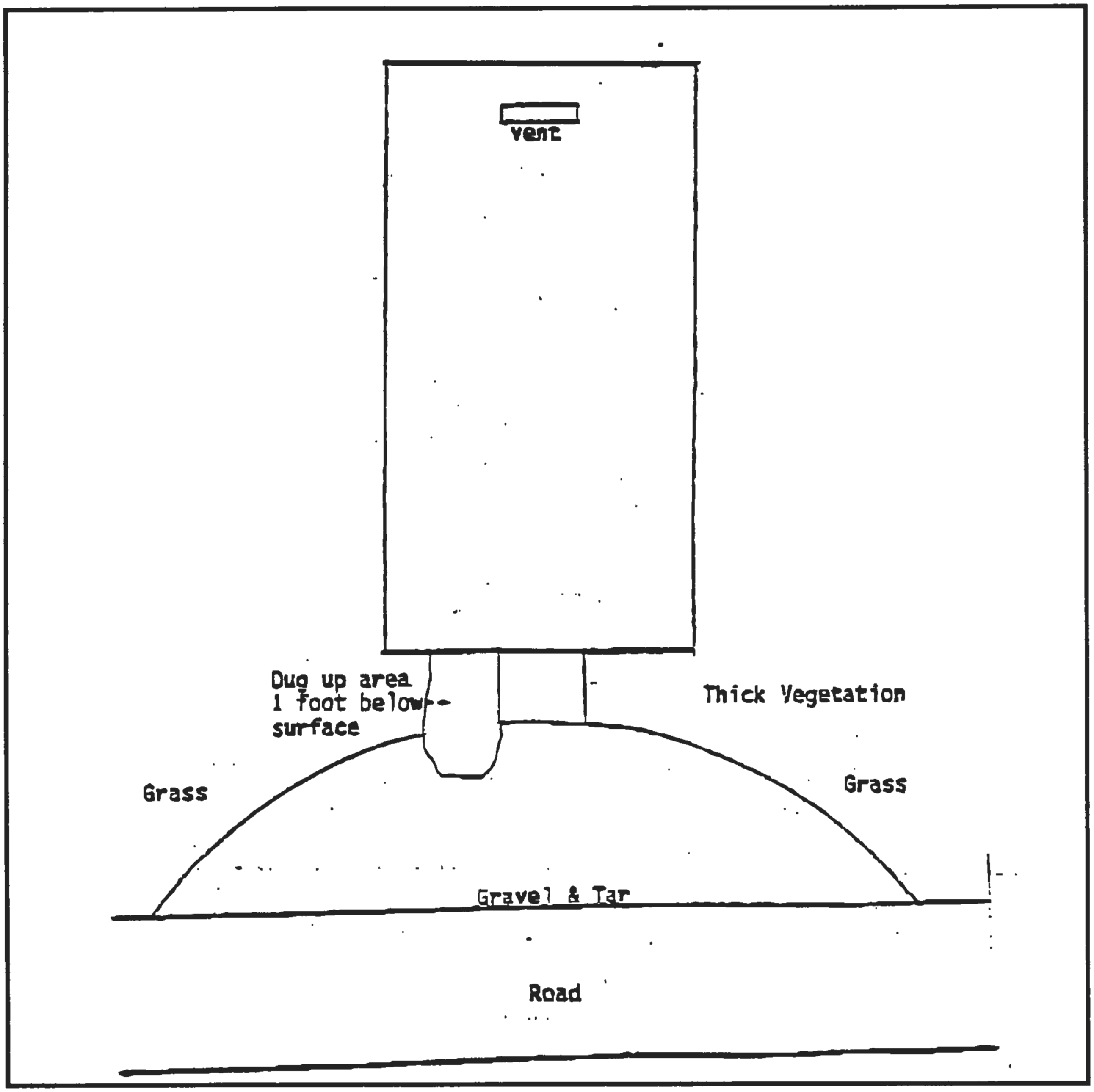
Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985. The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

Figure 1-10
The Approximate Extent of Excavation Activities at E0808
SEAD-48 Work Plan
Seneca Army Depot Activity



Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985.
The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

Figure 1-11
The Approximate Extent of Excavation Activities at E0809
SEAD-48 Work Plan
Seneca Army Depot Activity



Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985.
The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

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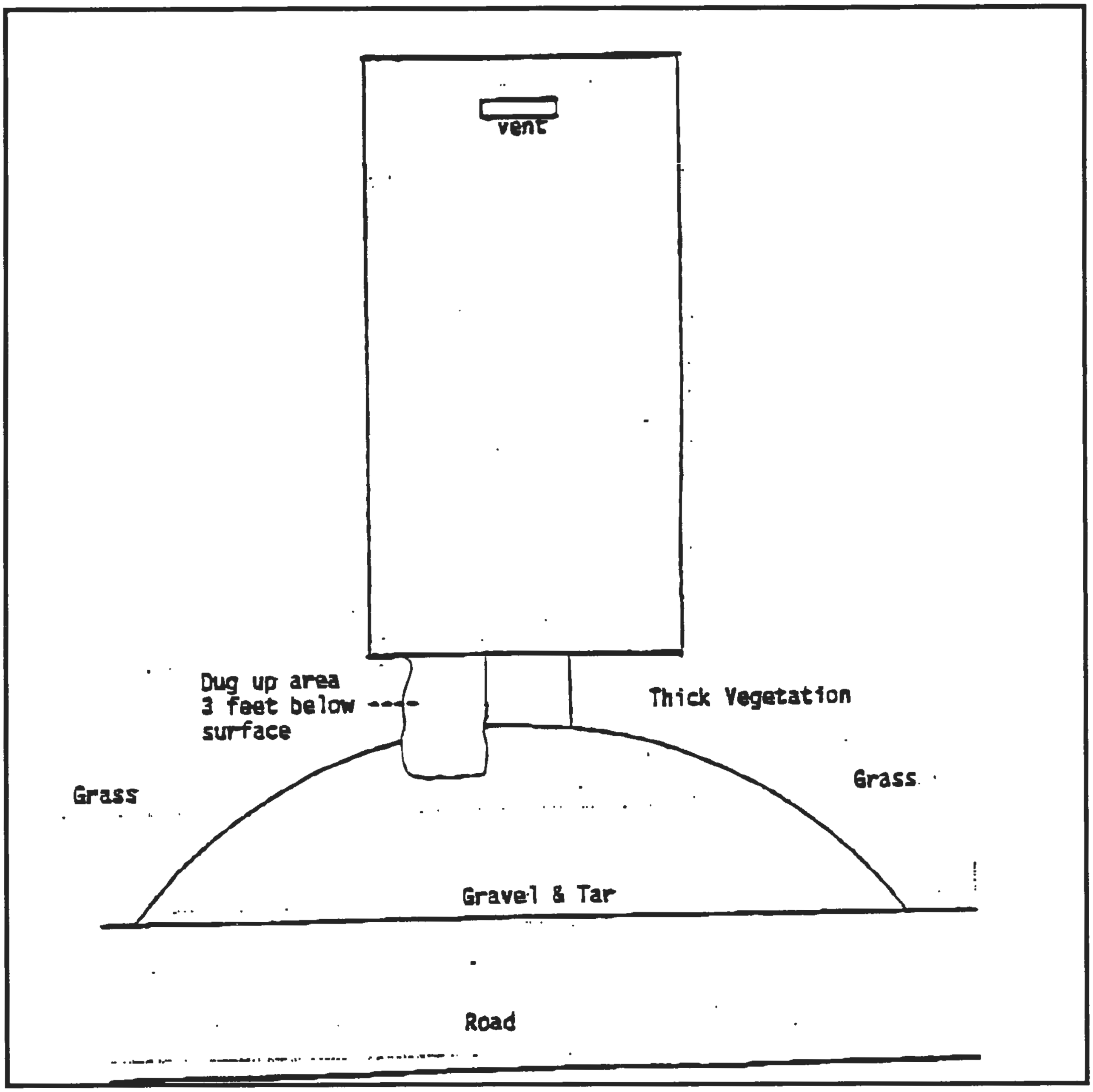
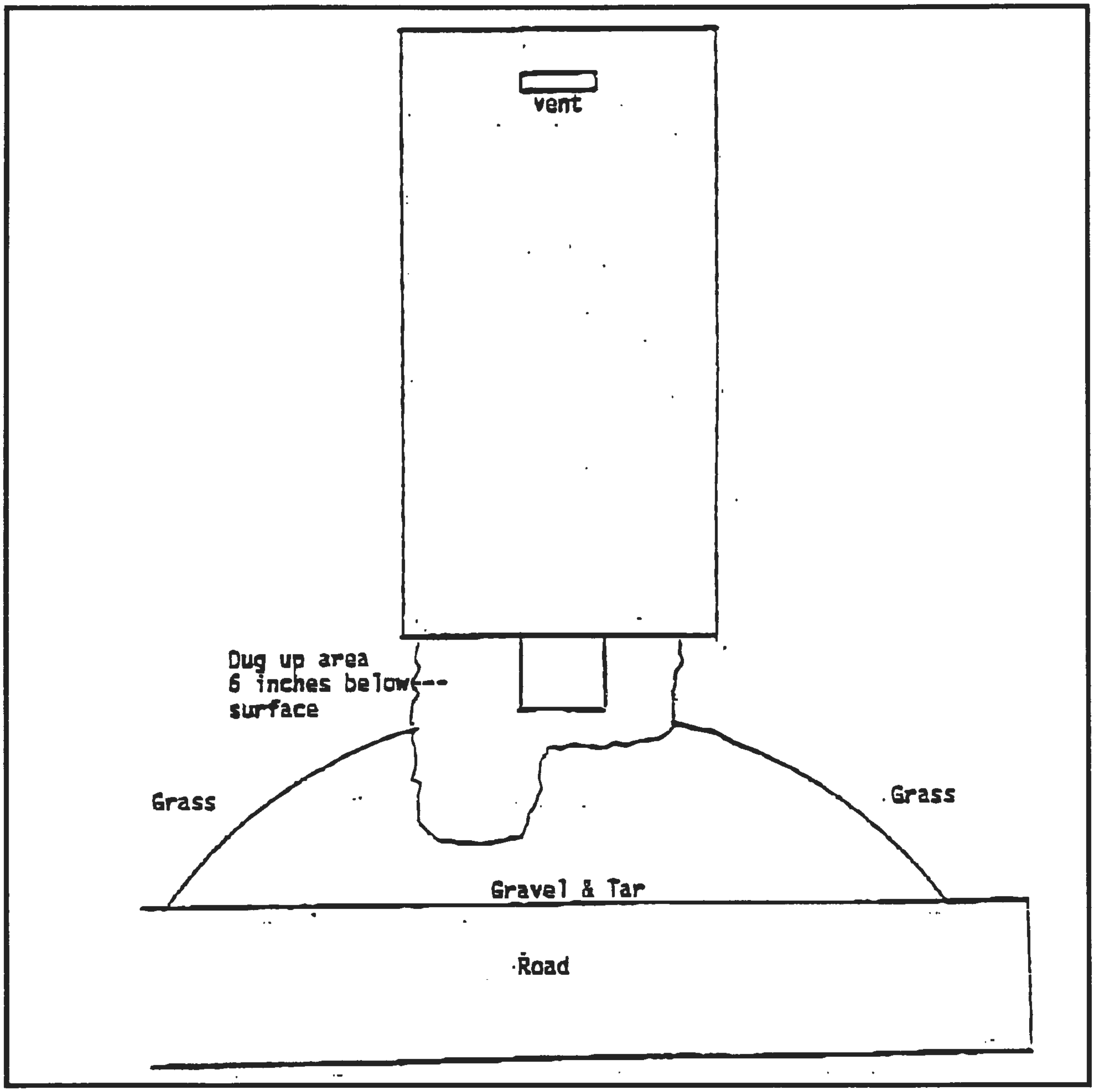
Figure 1-12
The Approximate Extent of Excavation Activities at E0810
SEAD-48 Work Plan
Seneca Army Depot Activity



Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985. The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

Figure 1-13
The Approximate Extent of Excavation Activities at E0811
SEAD-48 Work Plan
Seneca Army Depot Activity



Note: This drawing has been taken from the Close Out Survey of Bunkers EO 801-EO 811 by the Department of the Army, July 1985.
The schematic of the bunker is not drawn to scale. The bunker is approximately 26.8 x 81 .

Table 1-1
DOE 1976 Survey- Summary of Results
SEAD-48 Work Plan
Seneca Army Depot Activity

Igloo	Fixed Alpha Contamination Present? [a,f]	Transferable Alpha Contamination Present? [b,f]	Transferable Beta Contamination Present? [c,f]	Elevated Beta-Gamma Dose Rate? [d,f]	Elevated Radon? [e,f]
E0801	No	No	No	No	No
E0802	No	No	No	No	No
E0803	No	No	No	No	No
E0804	Yes	Yes	No	Yes	Yes
E0805	Yes	Yes	No	No	Yes
E0806	Yes	Yes	Yes	Yes	Yes
E0807	Yes	Yes	No	No	Yes
E0808	Yes	Yes	No	No	Yes
E0809	Yes	Yes	No	No	Yes
E0810	Yes	Yes	No	No	No
E0811	Yes	No	No	No	No

Notes:
a) The NRC Guideline that was used for fixed alpha contamination was an average of $100dpm/100cm^2$ and a maximum of $300dpm/100cm^2$. The igloos indicated in this table all have max values above $300dpm/100cm^2$.
b) The NRC Guideline that was used for transferable alpha contamination was $20dpm/100cm^2$.
c) The NRC Guideline that was used for transferable beta contamination was $1000dpm/100cm^2$.
d) The NRC Guideline that was used for beta-gamma dose rate was an average of 0.2mrad/hr and a maximum of 1.0mrad/hr (1 cm above surface). The igloos indicated in this table all have max values above 1.0mrad/hr.
e) The NRC Guideline that was used for radon was 0.03WL.
f) Information summarized from "Formerly Utilized MED/AEC Sites Remedial Action Program", DOE, February, 1979.

Table 1-2
RADCON 1985 Survey- Interior and Pad Maximum Readings
SEAD-48 Work Plan
Seneca Army Depot Activity

INTERIOR SURVEY

Igloo	FIDLER (cpm)	Pancake (mR/h)	PAC-1SA (cpm)	MicroR (uR/h)	Removable Alpha	Removable Beta
E0801	750	0.02	0	10	11	17
E0802	775	0.02	0	10	11	14
E0803	2140	0.02	100	9	17	9
E0804	609060	10.00	5000	250	566	952
E0805	3120	0.05	250	11	22	72
E0806	38150	0.85	16000	50	631	615
E0807	2360	0.03	100	9	22	14
E0808	7880	0.04	200	10	11	17
E0809	2540	0.1	300	8	17	21
E0810	8270	0.09	250	12	11	7
E0811	2580	0.2	900	10	78	93

PAD SURVEY

Igloo	FIDLER (cpm)	Pancake (mR/h)	PAC-1SA (cpm)	MicroR (uR/h)	Removable Alpha	Removable Beta
E0801	650	0.01	0	10	0	6
E0802	1150	N/A	0	12	6	3
E0803	2630	0.01	0	12	6	15
E0804	1363330	10.00	3500	2000	5	2
E0805	51530	0.5	150	90	6	1
E0806	16640	0.05	50	21	0	8
E0807	2520	0.03	0	10	0	0
E0808	79730	0.15	50	100	N/A	N/A
E0809	3190	0.02	0	7	N/A	N/A
E0810	25590	0.06	0	17	N/A	N/A
E0811	57500	0.5	0	150	N/A	N/A

Notes:
1. Source of data is *Radiological Survey of Seneca Army Depot, U.S. Army Ballistic Research Laboratory, January 1986*.
2. The numbers shown represent the highest value in each igloo between both the first team initial survey and the second team initial survey.
3. The surveys were completed in May, 1985 before decontamination activities by Army RADCON teams.
4. The survey was done on interior walls and floors of the igloos and the pad right outside the entrance of each igloo.
5. N/A = Not applicable. No survey data collected.

Table 1-3
RADCON 1985 Survey- Internal Drain Debris
SEAD-48 Work Plan
Seneca Army Depot Activity

Igloo	Concentration Levels	
	Ra^{226} (pCi/g)	U^{238} (pCi/g)
E0801	ND	ND
E0802	ND	ND
E0803	1.2 +/- 1.5	ND
E0804	12,080 +/- 45	9,274 +/- 100
E0805	280 +/- 3.3	90 +/- 6.0
E0806	150 +/- 1.9	54 +/- 3.5
E0807	15 +/- 2.0	4.0 +/- 2.2
E0808	ND	ND
E0809	300 +/- 4.7	59 +/- 8.1
E0810	12 +/- 1.7	ND
E0811	ND	3.2 +/- 1.4

Notes:
1. Source of data is *Radiological Survey of Seneca Army Depot, U.S. Army Ballistic Research Laboratory, January 1986*.
2. The surveys were completed in May, 1985 before decontamination activities by Army RADCON teams.
3. ND =Non-Detect value

2.0 BUILDING CLASSIFICATIONS

Storage Igloos E0801 through E0811 need to be classified as either Class I, Class II or Class III survey units based upon historic information, and the threat of residual radioactive contamination as part of the implementation of the MARSSIM process. MARSSIM provides guidance on the classification of buildings based upon past activities and is the basis for the classification system employed in this program. The percentage of building surfaces to be surveyed will be dependant on the classification of the survey area to ensure that potential residual radiation is detected. The lower the classification number, (Class I having the greatest potential for residual radiation), the greater the survey coverage.

2.1 MARSSIM AREA CLASSIFICATIONS

Impacted areas are defined as areas that have some potential for containing radioactive material. The interior and the exterior of the E0801 through E0811 storage igloos will be placed in one of the following three survey unit classes in accordance with MARSSIM guidelines:

- Class I Areas: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys). Examples of Class 1 areas include: 1) site areas previously subjected to remedial actions, 2) locations where leaks or spills are known to have occurred, 3) former burial or disposal sites, 4) waste storage sites, and 5) areas with contaminants in discrete solid pieces of material with high specific activity. Past radiological surveys and historic information would support a high probability of the area may contain measurement that would exceed the Derived Concentration Guideline Levels (DCGL), as defined by MARSSIM. DCGLs are defined in MARSSIM as residual levels of radioactive material that corresponds to allowable radiation dose standards. The recommended area for a Class I survey unit is 100 m^2 of floor area for a structure and up to 2000 m^2 for land areas (MARSSIM, 2000).

- Class II Areas: These areas have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. To justify changing an area's classification from Class I to Class II, the exiting data, (from the Historic Site Assessment (HSA), scoping surveys, or characterization surveys), should provide a high degree of confidence that no individual measurement would exceed the DCGLs. Other justifications for this change in an area's classification may be appropriate based on the outcome of the Data Quality Objectives (DQO) process. Examples of areas that might be classified as Class II for the final status survey include: 1) locations where radioactive materials were present in an unsealed form (e.g., process facilities), 2) potentially contaminated transport routes, 3) areas downwind from stack release points, 4) upper walls and ceilings of some buildings or rooms subjected to airborne radioactivity, 5) areas where low concentrations of radioactive materials were handled, and 6) areas on the perimeter of former contamination control areas. The recommended area for a Class II survey unit is 100 m^2 too 1000 m^2 of floor area for a structure and 2000 m^2 to 10,000 m^2 for a land area (MARSSIM, 2000).

- Class III Areas: 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 DCGL, based on site operating history and previous radiological surveys. Examples of areas that might be classified as Class II include buffer zones around Class I or Class II areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification. There is no limit recommended for the area of a Class III survey unit (MARSSIM, 2000).

2.2 CLASSIFICATION OF AREAS AT SEAD-48

It is postulated by MARSSIM that any area with "a potential for radioactive contamination or known contamination above the $DCGL_w$" should be classified as a Class I survey area. Although the pitchblende ore stored in the igloos at SEAD-48 contained high amounts of Radium and Uranium, the past surveys completed over the last several decades provide information and support to more accurately classify the igloos. **Table 2-1** and **Table 2-2** show justification for the interior and exterior area classifications, respectively.

Based on previous observations from the radiation surveys, the interiors of three of the eleven igloos have been designated as Class III survey units. Dating back to the 1970's, Igloos E0801 through E0803 were never recorded as having contamination levels that would be in exceedence of the DCGLs. The RADCON survey performed in 1985 did find trace amounts of Ra-226 (1.2 +/- 1.5 pCi/g) in the drain in Igloo E0803, however that amount would be considered a background level not in exceedence of the DCGLs. It can be concluded from the information collected in these past surveys that within these three igloos, no residual radioactivity would be found, or the levels would be at a small fraction of the DCGLs.

Each of the historical surveys indicates that igloo E0804 has contained the highest levels of residual contamination and would have the highest likelihood of exceeding the DCGLs. Therefore, the interior of igloo E0804 has been designated as Class I survey units. Igloos E0806 and E0808 have also been designated as Class I survey units based on results from the historical surveys.

The interiors of the remaining five igloos, E0805, E0807, and E0809 through E0811, have been divided into Class I and Class II survey units. Historically, the igloos did house pitchblende ore, and the past surveys do not provide enough confidence that the DCGLs would not be exceeded; however, the interior contamination generally appeared to be located on the lower walls and floor. The lower two meters of the walls and the floor will be classified and Class I while the upper walls that round into the ceiling will be classified as a Class II survey unit because the DCGLs are not expected to be exceeded. The dual classification is supported in MARSSIM (MARSSIM, p. 4-15) where it is stated: "Indoor areas may also be divided into several survey units of different classification, such as separating floors and lower walls from upper walls and ceilings."

There is documentation of a RADCON team in 1985 remediating the outside areas of the bunkers. It was recorded that over 90 tons of radiologically contaminated soil was removed from SEAD-48 and over 300 post-remediation samples were collected. **Figures 1-6** through **1-13** identifies generally the areas where the soil was removed. The post-remediation survey conducted by the Army indicates that there were no elevated readings of radioactivity, except for a localized area outside of Igloo E0804. Recently the road and aprons outside the igloos were repaired and re-graded. These activities could have effected the location and distribution of contamination if it existed.

Based on the high confidence that igloos E0801, E0802 and E0803 do not have levels of contamination exceeding DCGLs, the exterior areas of these igloos will be Class III survey units. Remediation by excavation has been completed on the exterior grounds of igloos E0804 and E0811, and the earth has since been moved around and covered over. In the surveys performed since the excavation, only Igloo E0804 had any detections of residual radiation; therefore, the exterior of Igloo E0804 will be considered a Class I survey unit. Due to the historic levels of radiation on the interiors of igloos E0806 and E0808, the exterior classifications have been designated as Class I survey units. The remaining igloos, E0805, E0807, and E0809 through E0811, had no detections of elevated radioactivity in any of the exterior surveys to follow the remediation; therefore, the exterior of those igloos will be considered Class II survey units. The outside areas of the bunkers will extend past the asphalt pads outside the igloos to include the grass areas to account for the possible spread of contamination during past activities.

Table 2-3 summarizes the classifications of the interior and exterior survey units at SEAD-48.

Table 2-1
Classification Justification for the Interior of SEAD-48 Igloos
SEAD-48 Work Plan
Seneca Army Depot Activity

Igloo	Radionuclides of Concern	Area Classification for Final Status Survey[a]		Historical Survey Results					Justification of Area Classification	Radiological Operations Performed	Other Licenses Affected
				Pre- Decontamination Activities		Post- Decontamination Activities					
		Lower Walls and Floor	Upper Walls and Ceiling	1976 DOE Survey/ 1980 FU&DU Survey	May 1985 RADCON Survey	1985 AEHA Closeout Survey	1987 NRC Closeout Inspection	1993 NYSDEC Survey			
E0801	Ra-226; Th-232; U-234; U-235; U-238	Class III	Class III	No Significant levels of radiological contamination detected.	No Significant levels of radiological contamination detected.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	Not included in survey.	Never recorded to have contamination levels that would exceed DCGLs	Assumed storage of Pitchblende Ore (1940s); Storage of depleted Uranium munitions	NRC License Termination (SUC-1275, SUC-1380)
E0802	Ra-226; Th-232; U-234; U-235; U-238	Class III	Class III	No Significant levels of radiological contamination detected.	No Significant levels of radiological contamination detected.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	Not included in survey.	Never recorded to have contamination levels that would exceed DCGLs	Assumed storage of Pitchblende Ore (1940s); Storage of depleted Uranium munitions	NRC License Termination (SUC-1275, SUC-1380)
E0803	Ra-226; Th-232; U-234; U-235; U-238	Class III	Class III	No Significant levels of radiological contamination detected.	Drain soil sample had elevated levels of Ra226.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	Not included in survey.	Never recorded to have contamination levels that would exceed DCGLs	Assumed storage of Pitchblende Ore (1940s)	NA
E0804	Ra-226; Th-232; U-234; U-235; U-238	Class I	Class I	Above NRC Guidelines for surface contamination of U235, U238, and associated decay products. Elevated Radon detected.	Fixed alpha exceeded 5000 dpm/100cm2. Dose rate > 1.0 mrad/year. Natural Uranium contamination on interior surfaces. Soil sample from drain had elevated levels of U238 and Ra226.	Highest gamma reading of 15uRem/hr)background = 10uRem/hr). Highest beta reading of 400-500 cpm (0-5 cpm = background). Some removable contamination detected. Considered to meet criteria for unrestricted use.	Released for unrestricted use.	Contamination detected. Further remediation necessary.	Historically high levels of residual radiation detected	Storage of Pitchblende Ore (1940s)	NA
E0805	Ra-226; Th-232; U-234; U-235; U-238	Class I	Class II	Elevated Radon detected.	Natural Uranium contamination on interior surfaces. Soil sample from drain had elevated levels of U238 and Ra226.	Highest gamma reading of 15uRem/hr)background = 10uRem/hr). Some removable contamination detected. Considered to meet criteria for unrestricted use.	Released for unrestricted use.	Not included in survey.	Residual radiation historically detected.	Storage of Pitchblende Ore (1940s)	NA
E0806	Ra-226; Th-232; U-234; U-235; U-238	Class I	Class I	Above NRC Guidelines for surface contamination of U235, U238, and associated decay products. Elevated Radon	Natural Uranium contamination on interior surfaces. Soil sample from drain had elevated levels of U238 and Ra226.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	No Significant levels of radiological contamination detected	Residual radiation historically detected.	Storage of Pitchblende Ore (1940s)	NA
E0807	Ra-226; Th-232; U-234; U-235; U-238	Class I	Class II	Elevated Radon detected.	Natural Uranium contamination on interior surfaces. Soil sample from drain had elevated levels of U238 and Ra226.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	Not included in survey.	Residual radiation historically detected.	Storage of Pitchblende Ore (1940s)	NA
E0808	Ra-226; Th-232; U-234; U-235; U-238	Class I	Class I	Elevated Radon detected.	Natural Uranium contamination on interior surfaces.	Highest alpha of 2000cpm (0cpm = background). Considered to meet criteria for unrestricted use.	Released for unrestricted use.	Contamination detected. Further remediation necessary.	Residual radiation historically detected.	Storage of Pitchblende Ore (1940s)	NA
E0809	Ra-226; Th-232; U-234; U-235; U-238	Class I	Class II	Elevated Radon detected.	Natural Uranium contamination on interior surfaces. Soil sample from drain had elevated levels of U238 and Ra226.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	No Significant levels of radiological contamination detected	Residual radiation historically detected.	Storage of Pitchblende Ore (1940s)	NA
E0810	Ra-226; Th-232; U-234, U-235; U-238	Class I	Class II	Elevated Radon detected.	Natural Uranium contamination on interior surfaces. Soil sample from drain had elevated levels of U238 and Ra226.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	Not included in survey.	Residual radiation historically detected.	Storage of Pitchblende Ore (1940s)	NA
E0811	Ra-226; Th-232; U-234; U-235; U-238	Class I	Class II	Elevated Radon detected.	Natural Uranium contamination on interior surfaces. Soil sample from drain had elevated levels of U238 and Ra226.	Considered to meet criteria for unrestricted use	Released for unrestricted use.	Not included in survey.	Residual radiation historically detected.	Storage of Pitchblende Ore (1940s)	NA

Notes:
a) Lower walls are considered to be 2 meters from the floor surface. Upper walls are considered to be the walls above 2 meters from floor surface.

Table 2-2
Classification Justification for the Exterior of SEAD-48 Igloos
SEAD-48 Work Plan
Seneca Army Depot Activity

Igloo	Radionuclides of Concern	Area Classification for Final Status Survey	Historical Survey Results						Justification of Area Classification	Other Licenses Affected
			Pre- Decontamination Activities		Decontamination Activity	Post- Decontamination Activities				
			1976 DOE Survey/ 1980 FU&DU Survey	May 1985 RADCON Survey	July 1985 Army Decontamination	1985 AEHA Closeout Survey	1987 NRC Closeout Inspection	1993 NYSDEC Survey		
E0801	Ra-226; Th-232; U-234; U-235; U-238	Class III	Surface soil samples collected near entrance were at background levels	No elevated activity detected. Surface water samples below allowable concentrations (10 CFR 20).	No soil excavation performed	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Not surveyed	Never recorded to have contamination levels that would exceed DCGLs	NRC License Termination (SUC-1275, SUC-1380)
E0802	Ra-226; Th-232; U-234; U-235; U-238	Class III	Surface soil samples collected near entrance were at background levels	No elevated activity detected. Surface water samples below allowable concentrations (10 CFR 20).	No soil excavation performed	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Not surveyed	Never recorded to have contamination levels that would exceed DCGLs	NRC License Termination (SUC-1275, SUC-1380)
E0803	Ra-226; Th-232; U-234; U-235; U-238	Class III	Surface soil samples collected near entrance were at background levels	No elevated activity detected. Surface water samples below allowable concentrations (10 CFR 20).	No soil excavation performed	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Not surveyed	Never recorded to have contamination levels that would exceed DCGLs	NA
E0804	Ra-226; Th-232; U-234; U-235; U-238	Class I	Had the highest residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	High levels of U^{238} and Ra^{226} detected across large areas outside of entrance. Exposure Rates measured at levels up to 1033uR/hr. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of up to 4 feet around the front pad.	One localized elevated reading of 150uR/hr found on gravel and tar area in front; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Elevated readings of U^{238} and Ra^{226} along concrete drainage ditch, in the drains that exit the igloo, and in the soil around the drains	Historically elevated levels detected; past remediation	NA
E0805	Ra-226; Th-232; U-234; U-235; U-238	Class II	Had residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	Elevated activity detected around entrance. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of up to 2 feet around the front pad.	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Not surveyed	Historically elevated levels detected; past remediation; no elevated levels detected in post-remediation surveys.	NA
E0806	Ra-226; Th-232; U-234; U-235; U-238	Class I	Had residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	Elevated activity detected around entrance. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of up to 1 foot around the front pad.	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Drain outlets surveyed and found to be with in background ranges	Historically elevated levels detected; past remediation; no elevated levels detected in post-remediation surveys.	NA
E0807	Ra-226; Th-232; U-234; U-235; U-238	Class II	Had residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	No elevated activity detected. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of up to 6 inches around the front pad.	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Not surveyed	Historically elevated levels detected; past remediation; no elevated levels detected in post-remediation surveys.	NA
E0808	Ra-226; Th-232; U-234; U-235; U-238	Class I	Had residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	Elevated activity detected around entrance. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of 3 feet around the front pad	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Drain outlets and drainage ditch surveyed and found to be with in background ranges	Historically elevated levels detected; past remediation; no elevated levels detected in post-remediation surveys.	NA
E0809	Ra-226; Th-232; U-234; U-235; U-238	Class II	Had residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	No elevated activity detected. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of 1 foot around the front pad.	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Drain outlets surveyed and found to be with in background ranges	Historically elevated levels detected; past remediation; no elevated levels detected in post-remediation surveys.	NA
E0810	Ra-226; Th-232; U-234, U-235; U-238	Class II	Had residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	Elevated activity detected around entrance. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of 3 feet around the front pad	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Not surveyed	Historically elevated levels detected; past remediation; no elevated levels detected in post-remediation surveys.	NA
E0811	Ra-226; Th-232; U-234; U-235; U-238	Class II	Had residual radiation levels in surface soil. Surface soil samples were below maximum allowable concentrations in (10 CFR 20).	Large area of elevated activity detected around entrance. Surface water samples below allowable concentrations (10 CFR 20).	Excavated to a depth of 6 inches around the front pad	No elevated reading; unrestricted use recommended	No radiation levels above background found. Released for unrestricted use.	Not surveyed	Historically elevated levels detected; past remediation; no elevated levels detected in post-remediation surveys.	NA

Table 2-3
Survey Unit Classifications
SEAD-48 Work Plan
Seneca Army Depot Activity

Igloo	Interior Classification-Lower Walls and Floor	Interior Classification-Upper Walls and Ceiling	Exterior Classification
E0801	Class III	Class III	Class III
E0802	Class III	Class III	Class III
E0803	Class III	Class III	Class III
E0804	Class I	Class I	Class I
E0805	Class I	Class II	Class II
E0806	Class I	Class I	Class I
E0807	Class I	Class II	Class II
E0808	Class I	Class I	Class I
E0809	Class I	Class II	Class II
E0810	Class I	Class II	Class II
E0811	Class I	Class II	Class II

Notes:

1. This table is a summary of **Tables 2-1** and **2-2** of this workplan.

3.0 FIELD METHODOLOGY

3.1 RADIONUCLIDES OF CONCERN

The pitchblende ore that was historically stored in the SEAD-48 igloos was natural uranium ore that consists of high levels of several radionuclides. The primary radionuclides of concern (ROCs) at SEAD-48 are Ra-226, Th-232, U-234, U-235, and U-238. Additionally contained in the pitchblende material is progeny of the ROCs: Th-230, Ra-228, Th-228, Pb-210, Pa-231, and Ac-227.

3.2 DERIVED CONCENTRATION GUIDELINE LEVEL

DCGLs are radionuclide-specific activity concentrations within a survey unit that are consistent with the applicable release criterion. Argonne National Laboratories (ANL), using the process described in MARSSIM, has derived the DCGL values against which the SEAD-48 survey units will be compared (ANL, January 2001). Section 6 of the ANL report, which can be found in **Appendix B**, discusses the development of the DCGLs that have been used at SEAD-48. Additional DCGLs that were not calculated by ANL were derived in this work plan for this survey using the same procedure as ANL. The soil DCGL values and building surfaces DCGLs derived by ANL are listed in **Tables 3-1** and **Table 3-2**, respectively. The additional gross DCGLs that were derived are listed in **Table 3-3**. The gross DCGLs were calculated using the isotopic DCGLs of the significant radionuclides that may be present and the natural activity fractions for those radionuclides. This was completed in accordance with Section 4.3.4 and Equation 4-4 of MARSSIM.

A DCGL is defined as the concentration of residual radioactivity distinguishable from background that, if uniformly distributed throughout a survey unit, would result in a defined total effective dose equivalent (TEDE) to an average member of a critical group. The TEDE selected for development of DCGLs at this site is the NYSDEC TAGM-4003 of 10 mrem/year. Although EPA allows a TEDE of 15 mrem/yr and the NRC allows a TEDE of 25 mrem/yr, this total effective dose equivalent was selected since it is the most conservative. See **Section 3.8** for the discussion of background reference areas.

Compliance with the DCGL values will be used to determine where guidelines are exceeded and remediation is necessary. Remediation work may include removal of soil from the exterior, sandblasting, grinding, scabbling, scrubbing walls and floors, cleaning the floor drains, and/or removal of parts of the igloo that prove to be contaminated.

If the initial survey does not satisfy final status survey requirements, the appropriate level of remediation will occur and the area of concern will be re-surveyed to verify that the closure criteria has been met.

3.3 INSTRUMENTATION

This section describes the different survey instruments that will be used to conduct the surveys. Field instrument efficiencies and Minimum Detection Amounts (MDAs) are presented in **Table 3-4**. **Appendix C** contains field survey forms and the condensed field instrument procedures for the field survey instrumentation. See **Appendix D** for detailed standard operating procedures (SOPs) for use of all of the instruments, including the in-situ gamma spectrometer.

3.3.1 Alpha and Beta Radiation Surveys

A Ludlum model 43-1-1 dual phosphor scintillator probe (phoswich) will be used to perform the alpha-beta survey for the interior wall and ceiling locations. A 43-37 large area gas proportional probe (Floor Monitor) will be used for interior floor locations. These instruments have probe areas of 75 cm^2 and 425 cm^2, respectively, and efficiencies of 0.15 to 0.20 cpm/dpm. The selection of these instruments is supported by MARSSIM in Table 6.4 (MARSSIM, 2000). The MDAs for these instruments are below the DCGL as shown in **Table 3-4**.

3.3.2 Gamma Radiation Surveys

A combination of measurements from the Bicron G5 FIDLER (FIDLER) and the 3"x3" NaI detector will be used to complete the gamma radiation surveys. The FIDLER can detect low energy gamma radiation and is effective at detecting the radionuclides of concern below the required DCGLs, i.e. its MDA for both scanning and direct measurements is below the respective DCGLs (refer to **Table 3-4**). Additionally, there is less background noise associated with the FIDLER than with the 3"x3" NaI detector. The 3"x3" NaI detector can detect a broader range of gamma emissions and is a better instrument for detecting radiation that is covered. However, the MDA for the 3"x3" NaI detector for direct measurements exceeds the required direct measurement DCGL and therefore is inadequate to detect elevated direct measurements. Due to each instruments advantages and disadvantages, the gamma radiation survey will be performed using both instruments as described below.

Radiation is not expected to be embedded within the interior surfaces of the igloos due to the nature of the activities at SEAD-48. Residual contamination within the igloos, if present, is likely to be at the surfaces of the floor or walls, not at depth. Therefore, it would not be advantageous to use the 3"x3" NaI detector. For the interior gamma surveys the FIDLER coupled with a Bicron Analyst portable count-rate meter will be used for the low energy gamma scanning and direct measurement surveys for the interior survey units. The interior gamma surveys will be supplemented with the alpha and beta surveys which will account for the alpha and beta components of the potential residual contamination.

A 3"x3" NaI detector will be used for the exterior gamma scanning surveys. As stated above, the scanning MDA for the 3"x3" NaI detector is below the $DCGL_{EMC}$ and is therefore appropriate for the exterior survey. For the exterior gamma direct measurement surveys, the FIDLER will be used because the MDA is below the DCGLw; whereas the 3"x3" NaI does not have an MDA below the DCGLw.

Table 3-4 compares the MDAs to the DCGLs for the FIDLER and the 3"x3" NaI. In order to achieve MDAs below the DCGLs with the FIDLER, the FIDLER will be used with a closed energy window having a range of 50-250 keV. Additionally, locations that are elevated above background for gamma radiation based on Wilcoxon Rank Sum (WRS) results or are above a conservative flag value that is set in the field, may be resurveyed with the URSA, as described in **Section 3.3.4**.

3.3.3 Exposure Rate Surveys

Exposure rate surveys will be conducted using a Bicron MicroRem meter as an initial screening of any potential contamination and to make sure that personnel are not exposed to high levels of radiation. Exposure rate surveys will be performed only as a diagnostic tool and for health and safety purposes. Maximum readings of twice background will be set as limits for an acceptable working area; readings above twice background would require a follow-up investigation with other instrumentation. Ambient exposure exceeding 500 uRem/hr would require a work stoppage.

3.3.4 In-Situ Gamma Spectroscopy Surveys

A Universal Radiation Spectrum Analyzer (URSA) attached to a NaI probe, which is an in-situ gamma spectrometer, will be used to assess areas both inside the igloos and in the exterior. In-situ spectroscopy allows for the evaluation of energy spectra to determine the levels of isotopes present in a real-time basis. Additionally, use of the URSA in the field will assist the survey teams in determining the extent of contamination and the need for additional investigation and/or remediation. The URSA will be used with either the FIDLER or with a 3x3 NaI detector. **Figures 3-1** and **3-2** illustrate how the in-situ gamma spectrometer is used in conjunction with the gamma survey measurements and the samples collected for laboratory isotopic analysis for the interior and exterior surveys, respectively. The URSA is used as a screening instrument to evaluate the potentially elevated areas identified in the radiological survey to best determine which samples to send to the laboratory for isotopic analysis.

For sample locations evaluated using the URSA, approximately 5% of these samples will be sent to an approved off-site laboratory for confirmatory U-238, U-235, and Ra-226 isotopic analyses using gamma spectroscopy. These data will be used to confirm and correlate the site results of the URSA. General Engineering Laboratories, Inc. (GEL) has been selected to perform the isotopic analyses. Justification for the use of GEL is explained in letters to the EPA and to NYSDEC dated November 19, 1999 and November 22, 1999. GEL is USACOE certified for radiological analysis and NYSDOH ELAP certified for Radiological Analysis in Water. Refer to **Table 3-5** for laboratory MDAs.

3.3.5 Radon Surveys

Radon surveys will be conducted using short-term deployment E-perm electret devices to measure the ambient radon concentration within each of the eleven igloos. The E-perm devices have a known electrostatic voltage on the electret; when the radon decays within the device the ionization causes the neutralization of some of the charge on the electret resulting in a decrease in the voltage across the electret. This potential difference is measured using an electret reader and is quantified back to a radon concentration. The E-perm device will be placed and left undisturbed in the igloo for approximately five days to provide a reasonable measure of the radon emission rate, which may fluctuate over short time periods due to meteorological conditions. This survey will include measurements in several background igloos since it is important to consider these results relative to the ambient background because of the potential for high levels of background radon emissions from the soils and concrete in the area. Several devices may be placed in each igloo to provide better accuracy in determining the radon concentration. The results will then be used to provide information about whether residual contamination above naturally-occurring levels is present. The radon levels in the background igloos will be evaluated against the radon levels in the SEAD-48 igloos to determine if source material, above natural background levels, that is present in the igloos. These measurements will be used as a preliminary assessment of the naturally occurring radioactivity and will not provide actual surface contamination levels. The radon surveys will provide ambient radon concentrations that will be used to assess the influence of naturally-occurring radon and radon progeny on direct alpha and beta measurements within the igloos.

The basis of selection of short-term deployment E-perm electret devices is supported in MARSSIM Table 6.3 (MARSSIM, 2000).

3.3.6 Instrument Function Check Procedure

To insure the highest quality data possible are collected during the survey program, all radiation survey data will be collected using laboratory calibrated radiation survey instruments, except for the URSA based multi-channel analyzer (MCA) assessments. The URSA will be calibrated in the field using NIST traceable calibration sources, consistent with the manufacturers recommendations. **Table 3-6** identifies the appropriate National Institute of Standards and Technology (NIST) calibration source for each of the instruments used in the SEAD-48 radiological survey. All surveying instruments will have been calibrated within a 12-month time frame, with the exception of the Bicron MicroRem, which is calibrated every 6 months.

In addition to the periodic laboratory calibrations, function checks will be completed over the duration of the survey period to demonstrate that the instrument is operating properly. This will be done by collecting a background and source reading every morning, afternoon and evening that the instrument is being used. The reading will be input into a control chart that will plot the distribution of the data. Tracking the distribution using this method will allow for the identification of a mis-operating instrument. The first five days` that the instrument is being used the readings will be considered to be properly operating if they are within +/- 20%; after 5 days there will be enough data to have an accurate distribution curve to identify uncertainty with in a 2 sigma range. This function check procedure will account for the variability associated with temperature, pressure, background, electronics, etc. in assessing the status of the equipment. All checks will be done using NIST traceable radioactive sources that are checked every two years to ensure that the emission rates, which are used to determine the field efficiencies of the instruments, are accurately known. The NIST traceable radioactive sources are also checked when there is reason to suspect that they may have been damaged.

3.3.7 Quality Assurance/Quality Control Testing

Quality assurance and quality control (QA/QC) measures will be used throughout the program to ensure the certainty of the data collected for the surveys. Survey technique and procedures will be utilized to assure the consistency of the sampling methods. All measurements collected will be properly documented. The instrument serial number, the measurement location, the output, the surveyor, and the date the measurement was collected will all be recorded. See **Appendix C** for the field survey forms. These forms are used to record the data to ensure that all the necessary measurements are collected and properly documented. Additionally, **Appendix C** contains the instrument procedures for each of the radiological instruments employed in this FSS. A supplemental Quality Assurance Project Plan (QAPP) is included in **Appendix D**.

All potentially elevated locations will be further investigated and clearly documented so that, if necessary, the location can be easily located again. Instrument flag values based on the DCGLs (see **Table 3-4**) have been established and will be used in the field to determine if a potentially elevated location exists. For Class I and Class II surveys, additional alpha, beta, and gamma direct measurements and a smear sample will be collected and documented on the "Hotspot Survey Form" located in **Appendix C**. If a direct measurement exceeds a field instrument flag value in a Class III survey, then the areas will be scanned and additional direct measurements and smear samples will be collected at the location with the highest measurements. Additionally, in-situ gamma spectroscopy measurements may be collected. The location of the potentially elevated location will be clearly documented in the logbook with all relevant comments.

3.4 CLASS I SURVEY

3.4.1 Interior Surveys

Igloos E0804, E0806, E0808, and the lower two- meters of the walls and floor of Igloos E0805, E0807, E0809, E0810, and E0811 are considered Class I survey units based on the information and conclusions in the previous sections (see **Table 2-3**). Therefore, the investigation of these igloos will be the most intensive and comprehensive in terms of analysis. All surfaces within a Class I survey unit will receive 100% coverage. This is supported in Table 2 of the MARSSIM roadmap (MARSSIM, 2000). In order to establish a reference coordinate system, the survey units will be divided into grids. These grids will facilitate the selection of measurement and sampling locations and will provide a mechanism for referencing a measurement to a specific location so that the same survey point can be relocated (MARSSIM, 2000). The subsets will be surveyed according to the following frequency:

1. 100% of the following surfaces conducted in 2 meter by 2 meter grids at igloos E0804 through E0811:
   - Lower walls, (up to 2 meters above floor level);
   - Doors and doorframes;
   - Floor surfaces;

2. 100% of the following surfaces conducted in 1 meter by 1 meter grids at igloos E0804, E0806, and E0808:
   - Upper walls, (2 meters or greater above floor level);
   - Ceilings.
   - Horizontal surfaces above 2 meters; and
   - Horizontal surfaces above floor level where dust or particulate material could deposit.

3. 100% of drain gutters and air vents on the doors and ceilings.

In accordance with the frequencies described above, the following survey measurements will be collected within the survey area:

- Alpha, beta, and gamma scanning measurements;
- Alpha, beta, and gamma one minute direct measurements collected at the center of each 2m x 2m or 1m x 1m grid, and on each drain gutter and air vent;
- Exposure rate measurements collected at the center of each 2m x 2m or 1m x 1m grid at 1 meter from the floor/soil surfaces; and
- Gross alpha, beta, gamma smear measurements at the center of each 2m x 2m or 1m x 1m grid, and on each drain gutter and air vent.

Each of the grids will be assigned a unique grid number. The grid number will be combined with the igloo number to form a unique grid number, i.e. 804-1. The exposure rate measurements will be collected first to ensure that the field personnel are working in a safe radiological environment and to assess the ambient dose rate in the area. The scanning and direct measurements with the FIDLER, the phoswich, and the smears will follow. URSA measurements will be collected within each of the eight igloos at the two locations having the highest gamma readings. In areas of elevated activity, upon the discretion of the field health physicist, additional readings with the URSA may be taken to identify and to facilitate quantification of the radiological contaminants; additional material samples may also be collected at the discretion of the health physicist. Refer to **Figure 3-1** for additional clarification on the collection of interior survey measurements and samples.

3.4.2 Exterior Surveys

The exteriors of igloos E0804, E0806, and E0808 are Class I survey units (see **Table 2-3**). Refer to **Figure 3-3** for the location and approximate extent of the survey units. The outside asphalt and grass area will be divided into 10 x 10 meter square grids and will be surveyed with the 3"x3" NaI at a frequency of 100%. This coverage will include the areas where the drainage openings exit the igloos and the roof vents on the top of the igloos. At the center of each grid, a direct measurement will be collected with the FIDLER. For each igloo, five URSA readings will be collected at the locations having the highest gamma readings.

Unless surveys indicate that further investigation is necessary, the base of the igloo mound will serve as the southern survey boundary. The extent for the eastern and western survey boundaries will be determined based on where the large stands of aged trees begins. The extent of contamination is not expected to reach into these heavily wooded areas, consequently, these areas will be excluded from the exterior survey as long as the proposed survey area confirms that further investigation is not necessary. The cleared area for each exterior survey unit is approximately 2,700 m^2.

The outside concrete pads at the entrance of the igloos will be scanned with the FIDLER at a frequency of 100%. On each pad a direct measurement with the FIDLER, in addition to an URSA measurement, will be collected at the location having the highest scanning reading.

At each of the igloos (E0804, E0806, and E0808) a soil boring will be collected at the location of each of the drain outlets. Additionally, three soil borings will be will be collected at locations determined by the gamma surface scans. The locations will be biased to areas where past remediation has occurred. If gamma surface scanning does not indicate that radioactivity levels are elevated above background, soil borings will be collected at location in the survey unit where prior remediation has occurred (refer to Figures 1-6 through 1-13). The depth of the borings will range from 3-11.5 feet depending on the radiation levels. To examine the radiation gradient in the soil, each core from the boring will be surveyed with a 3" x 3" NaI detector and with the FIDLER. The core removed will also be surveyed with a GM pancake probe for health and safety purposes. The first 6-inches of the core that is not asphalt will be considered surface soil; the remainder of the core will then be divided into 2-foot increments. Each section of the core will be composited; localized contamination would be separated and sampled independently. The asphalt and soil core sections would be treated as separate samples. A minimum of one URSA reading will be collected from each soil boring to determine if there is subsurface contamination, and if there is, at what depth the contamination reaches. A minimum of one soil sample from each of the soil borings will be collected and sent to an approved laboratory for U-234, U-235, U-238, and Ra-226 isotopic analysis. Refer to The Exterior Surveys Flowchart (**Figure 3-2**) for additional clarification on the collection of the exterior survey measurements and samples. **Figure 3-4**, Soil Boring Collection and Analysis Flowchart, gives specific details on the SEAD-48 soil boring program. The soil sampling strategy is based on the EPA Soil Screening Guidance for Radionuclides (EPA Publication 9355.4-16A).

Since the previous surveys, new asphalt has been paved in front of the igloos. The moving of material and earth makes it possible for contamination to have been locally spread around within the surface soils or to have been buried under the new asphalt. The survey coverage and the borings have been designed to detect this contamination if it exists. Areas where there has been past remedial excavations performed and areas that have had historically elevated radiological levels have been designated to receive 50 to 100% coverage on the surface. Soil borings to evaluate sub-surface radiological levels will be focused in areas where contamination would be likely if it exists.

3.5 CLASS II SURVEYS

3.5.1 Interior Surveys

The walls above two -meters and ceilings in igloos E0805, E0807, E0809, E0810, and E0811 are considered Class II survey units based on the information and conclusions in the previous sections (see **Table 2-3**). The survey will cover the area according to the following frequency:

1. 50% of the following surfaces conducted in 1-meter by 1-meter grids:
   - Upper walls, (2 meters or greater above floor level);
   - Ceilings;
   - Horizontal surfaces above 2 meters; and
   - Horizontal surfaces above floor level where dust or particulate material could deposit.
2. 100% of drain gutters and air vents on the doors and ceilings.

Class II interior survey areas will be scanned and surveyed using the same procedure as the Class I interior surveys. Refer to **Figure 3-1** for additional clarification on collection of the interior survey measurements and samples.

3.5.2 Exterior Surveys

The exterior of Igloos E0805, E0807, E0809, E0810 and E0811 are classified as Class II survey units (see **Table 2-3**). Refer to **Figure 3-3** for the location and approximate extent of the survey units. The outside asphalt and grass area of each igloo will be divided into 10 x 10 meter square grids and will be surveyed with the 3" x 3" NaI at a frequency of 50%. Included in the coverage will be the areas where the drainage openings exit the igloos and the roof vent on top of the igloos. Unless surveys indicate that further investigation is necessary, the base of the igloo mound will serve as the southern survey boundary and the eastern and western boundaries will be determined by the thick stands of aged trees, as with the Class I exterior surveys. At the center of each grid a direct measurement will be collected with the FIDLER. For each igloo, three URSA readings will be collected at the locations having the highest gamma readings.

The outside concrete pads at the entrance of the igloos will be scanned with the FIDLER at a frequency of 100%. On each pad a direct measurement with the FIDLER, in addition to an URSA measurement, will be collected at the location with the highest gamma scanning reading.

At each of the igloos (E0805, E0807, E0809, E0810 and E0811) a soil boring will be collected at the location of each of the drain outlets. Additionally, at two soil borings will be collected at locations determined by the gamma surface scans. These areas would be biased to where previous remediation had occurred. If gamma surface scanning does not indicate that radioactivity levels are elevated above background, soil borings will be collected at location in the survey unit where prior remediation has occurred (refer to Figures 1-6 through 1-13). They will be analyzed in the same way as in the Class I surveys. A soil sample from each of the soil borings will be collected and sent to an approved laboratory for U-234, U-235, U-238, and Ra-226 isotopic analysis. Refer to **Figure 3-2** for additional clarification on the collection of the exterior survey measurements and samples. **Figure 3-4**, Soil Boring Collection and Analysis Flowchart, gives specific details on the soil boring program.

3.6 CLASS III SURVEYS

3.6.1 Interior Surveys

Igloos E0801, E0802, and E0803 are considered impacted Class III areas but are expected to contain levels of residual radioactivity at a small fraction of the DCGL based on the site operating history and previous radiological surveys. The final status survey for these three igloos will involve the collection of 30 random direct measurements with the MicroRem, the FIDLER, and the Phoswich. Gross alpha, beta, and gamma smears will also be collected. These samples will be biased to areas with the highest potential for contamination, such as the air vents, the corners, light switches, and door handles. The doorframe and the door will be scanned with each of the above-mentioned instruments.

3.6.2 Exterior Surveys

The exteriors of igloos E0801 through E0803 are Class III survey units; see **Figure 3-3** for the location and approximate extent of the survey units. Thirty random direct measurements with the FIDLER will be collected in the grass and asphalt areas for the final status survey. One URSA measurement will be collected at the location having the highest gamma reading. Unless surveys indicate that further investigation is necessary, the base of the igloo mound will serve as the southern survey boundary and the eastern and western boundaries will be determined by the thick stands of aged trees, as with the Class I and Class II exterior surveys.

At each of the igloos (E0801, E0802, and E0803), a soil boring will be collected at the location of each of the drain outlets. Additional soil borings will be collected at the discretion of the health physicist. The soil borings would be analyzed using the same methodology as those collected in the Class I and Class II exterior surveys.

The outside concrete pads at the entrance of the igloos will be scanned with the FIDLER at a frequency of 100%. A direct measurement with the FIDLER, in addition to an URSA measurement, will be collected at the location with the highest scanning reading.

3.7 GROUNDWATER INVESTIGATION

The groundwater investigation program will consist of collecting groundwater samples from eight groundwater monitoring wells. The goals of the groundwater investigation are to determine if there is residual radiation present in the groundwater from past activities at SEAD-48. To make this determination, eight wells will be installed. Six of those wells are downgradient of groundwater and surface water flow along the drainage ditches; two are upgradient or cross-gradient of the site. The proposed locations of these wells are in **Figure 3-5**. **Table 3-7** presents the justification for the placement of the groundwater monitoring well placement.

The eight soil borings to be drilled for the installation of the eight monitoring wells will be continuously sampled to competent bedrock. A monitoring well will then be installed and screened in the saturated overburden overlying the bedrock. These eight monitoring wells will then be sampled according to the following schedule:

- First Round – approximately 2 weeks after well development; and
- Second Round – approximately 3 months after the first round.

Monitoring well installation, development, and sampling procedures are described the Generic Installation Work Plan (Parsons, June 1995). All wells will be properly developed prior to sampling. In the field, the groundwater samples will be analyzed for pH, temperature, specific conductivity, and turbidity. These parameters are being tested to verify that the well is stabilized and that a representative sample is being collected. The collected groundwater samples will be sent to General Engineering Laboratories, Inc. for isotopic analysis of U-234, U-235, U-238, Ra-226, Ra-228, Th-232 and gross alpha. Additionally, the samples will undergo chemical analysis of total uranium.

3.8 BACKGROUND REFERENCE AREAS

To represent background radiological conditions at the site and to provide reference areas for conducting statistical comparisons of study areas, measurements will be made in reference areas that have not been affected by site operations. Igloo C0912 will be used as the background reference area for the SEAD-48 radiological survey. This igloo has not been used for any radiological storage and has been used as a reference area in past radiological surveys at SEDA. Both interior and exterior surveys will be completed for comparisons against the interior and exterior survey areas at SEAD-48.

Figure 3-1
Interior Surveys Flowchart
SEAD-48 Work Plan
Seneca Army Depot Activity

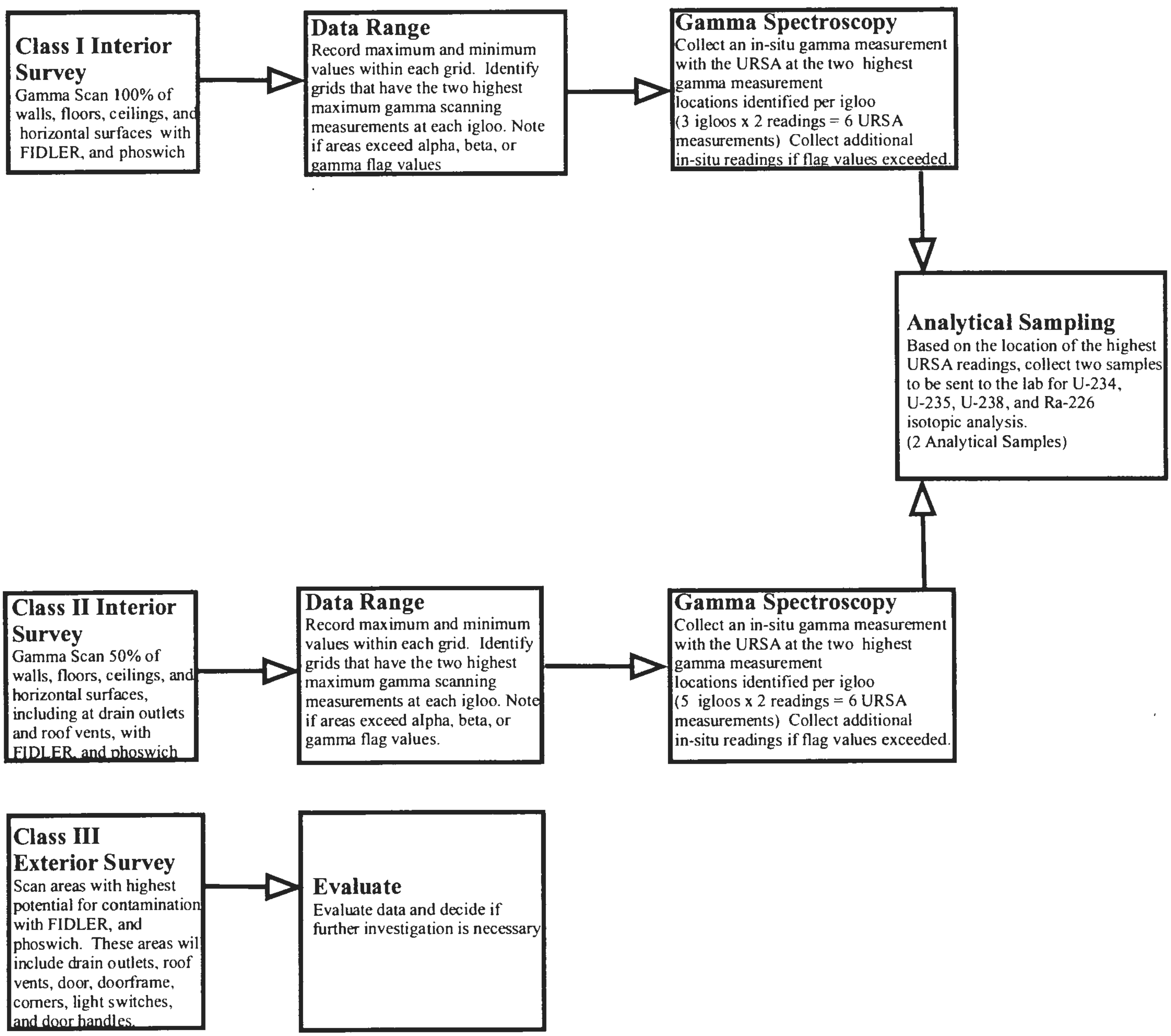


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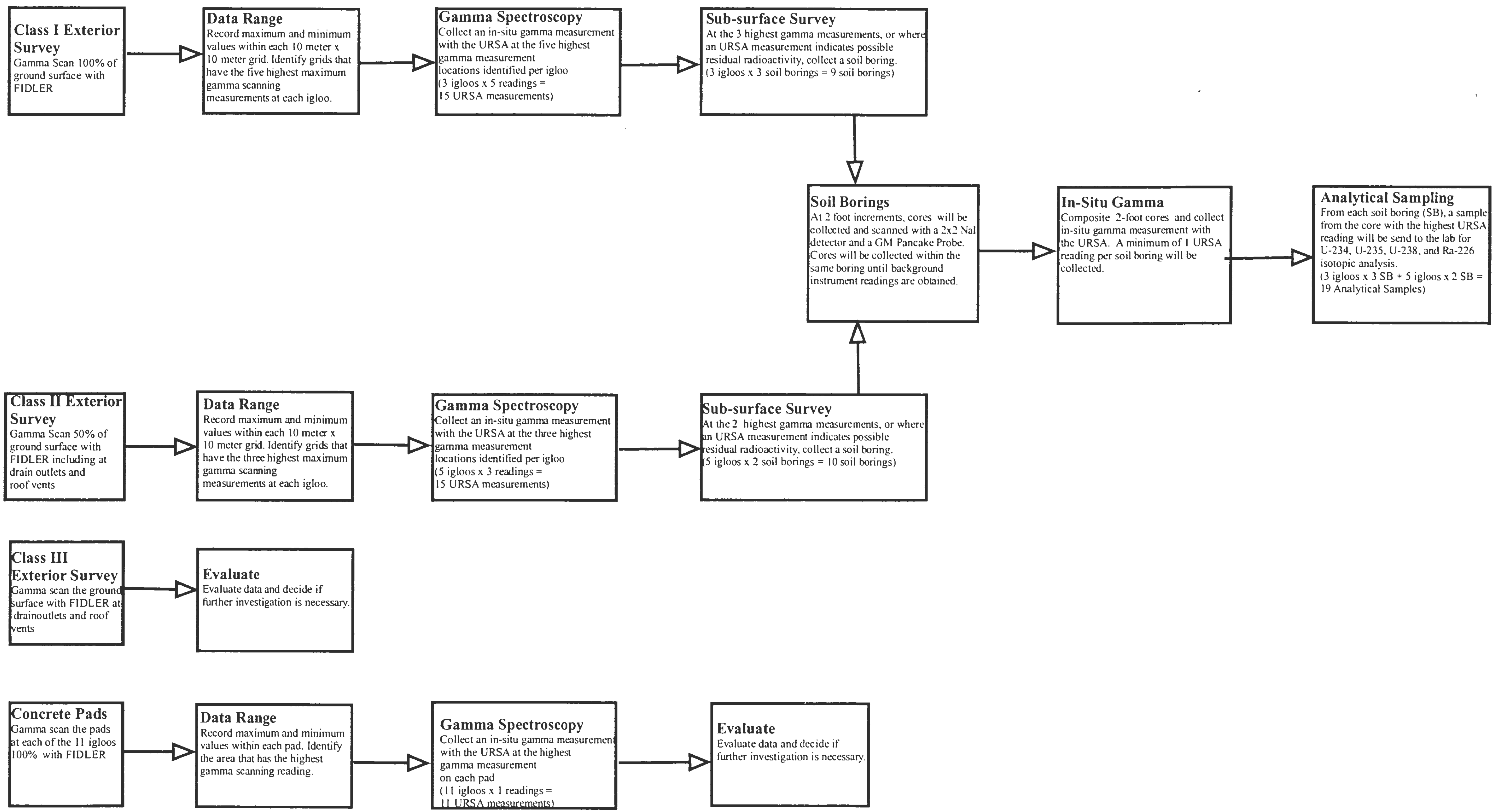
Figure 3-2
Exterior Surveys Flowchart
SEAD-48 Work Plan
Seneca Army Depot Activity



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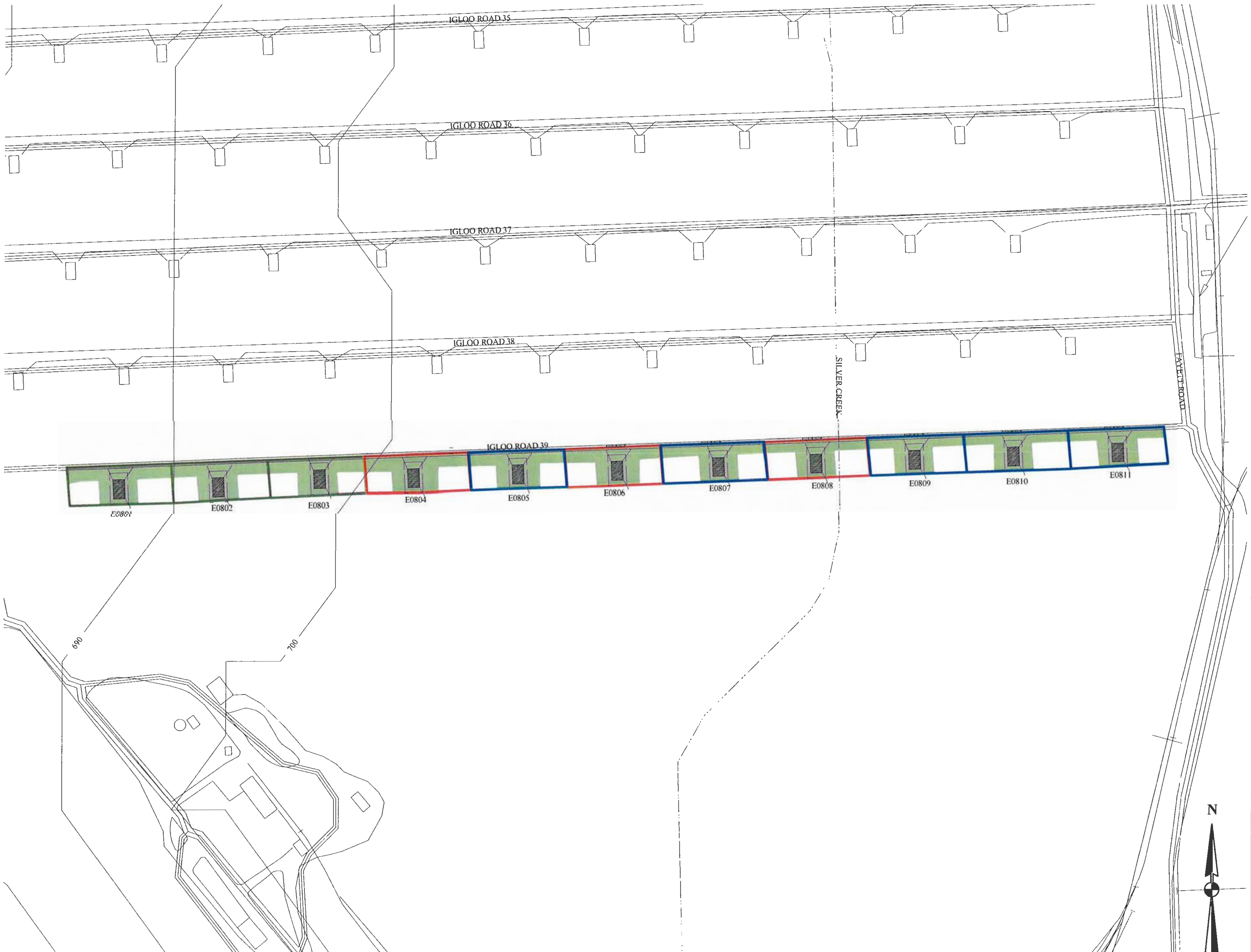
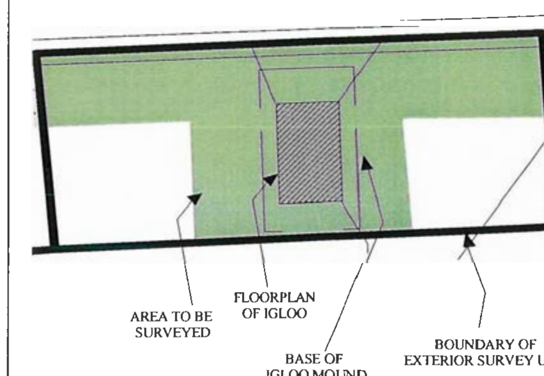


LEGEND

- CLASS I AREA
- CLASS II AREA
- CLASS III AREA
- WATERWAY
- 10-FOOT GROUND ELEVATION
- AREA THAT IS NOT COVERED WITH STANDS OF LARGE, AGED TREES. EXTENT OF EXTERIOR SURVEY

KEY



NOTE:
1.)SEE SECTION 3.0 OF THE WORKPLAN FOR A DESCRIPTION OF THE FIELD METHODOLOGY FOR CLASS I, CLASS II AND CLASS III EXTERIOR SURVEYS.

2) THE AREA TO BE SURVEYED WILL BE DIVIDED INTO 10 METER BY 10 METER GRIDS TO CONDUCT THE SURVEY.

400 0 400
(feet)

PARSONS

SENECA ARMY DEPOT ACTIVITY
FINAL WORK PLAN
SEAD 48 (800 ROW STORAGE IGLOOS)

FIGURE 3-3
EXTERIOR SURVEY LOCATIONS

SCALE 1:400	DATE NOVEMBER 2002	REV SHEET 1 OF 1

O:\Sene d-48\Base.apr

LEGEND

MW48-1 PROPOSED MONITORING WELL LOCATION

WATERWAY

10-FOOT GROUND ELEVATION

SURFACE WATER FLOW (IN CREEKS AND DRAINAGE DITCHES)

GROUNDWATER FLOW DIRECTION

NOTES:

1.) SURFACE WATER FLOW FROM PRECIPITATION EVENTS IS CONTROLED BY LOCAL TOPOGRAPHY AND THE DRAINAGE DITCHES THAT LIE ALONG IGLOO ROAD NO. 39. IN EACH OF THESE PATHWAYS, THE SURFACE WATER FLOW IS EVENTUALLY TO SILVER CREEK OR INDIAN CREEK.

2.)IN THE EASTERN PORTION OF SEAD-48 GROUNDWATER WOULD BE EXPECTED TO FLOW TOWARDS INDIAN CREEK. FOR THOSE AREAS WEST OF IGLOO E0806 GROUNDWATER WOULD BE EXPECTED TO FLOW TOWARDS THE WEST.

700 0 700
(feet)

PARSONS

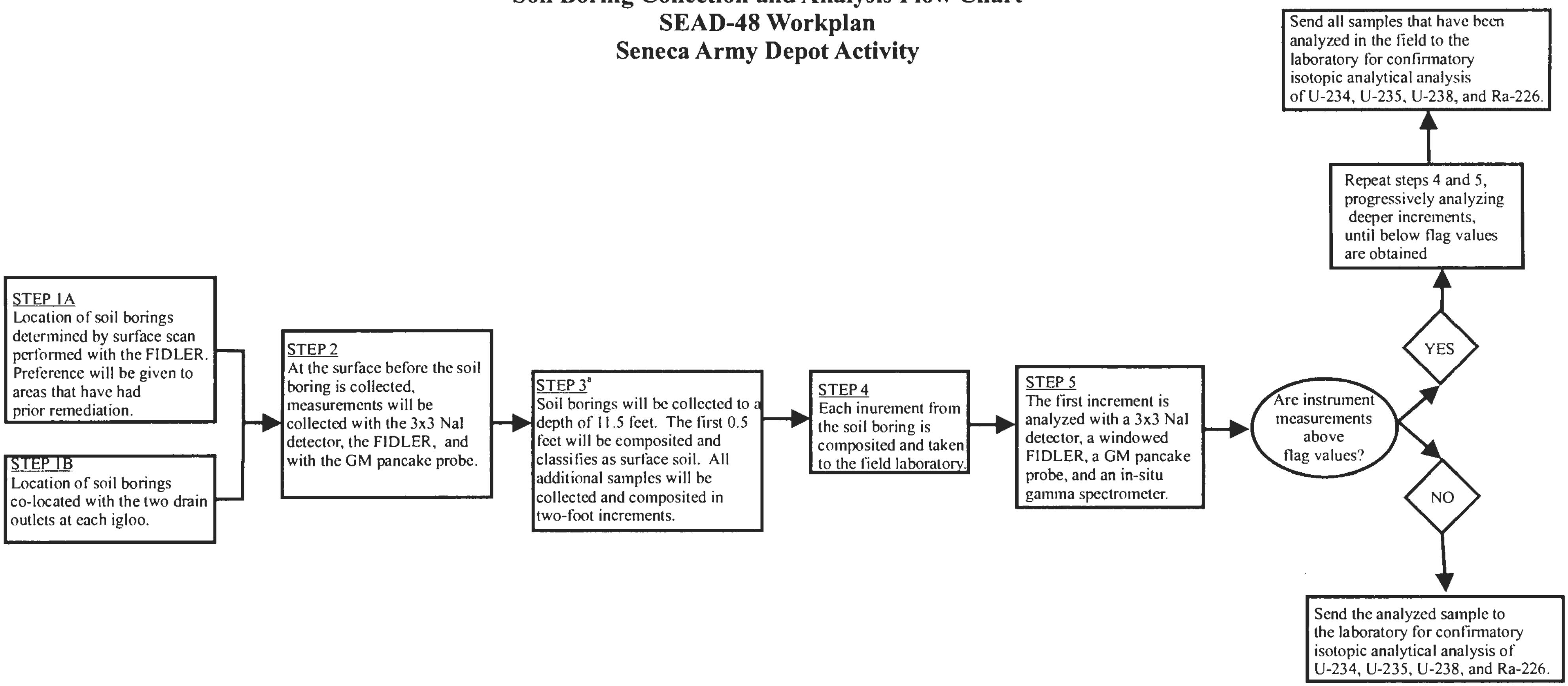
SENECA ARMY DEPOT ACTIVITY

FINAL WORK PLAN
SEAD 48 (800 ROW STORAGE IGLOOS)

FIGURE 3-5
PROPOSED MONITORING WELL LOCATIONS

SCALE	DATE	REV
1:700	NOVEMBER 2002	SHEET 1 OF 1

Figure 3-4
Soil Boring Collection and Analysis Flow Chart
SEAD-48 Workplan
Seneca Army Depot Activity



Notes:
a) Asphalt and soil will be treated independently in the analysis of surface soil in the soil borings.

Table 3-1
Soil DCGLw for the Residential Scenario [1]
SEAD-48 Work Plan
Seneca Army Depot Activity

Igloo	Wide-Area DCGLs (pCi/g) [2]
H-3	1.83E+03
Pm-127	8.54E+04
Pu-239	5.61E+01
Ra-226	3.43E-01
Ra-228	1.88E+00
Th-228	2.44E+00
Th-232	1.14E+00
U-234	2.64E+02
U-235	2.26E+01
U-238	1.03E+02

Notes:

1. Source of DCGLs is *Seneca Army Depot Activity License Termination and License Release Plan*, Argonne National Laboratory- Environmental Assessment Division, 2002, page 6-15.
2. The DCGL values are for single radionuclides at a dose limit for 10mrem/yr.
3. The activity fractions presented in this table were used to determine a gross activity DCGL; in determining the gross activity DCGL the Sum of Ratios was taken into account.

Table 3-2
Building Surface $DCGL_w$'s (dpm/100cm^2) at a Dose Limit of 10 mrem/yr for the Building Occupancy Scenario at the Seneca Army Depot Activity
SEAD-48 Work Plan
Seneca Army Depot Activity

Radionuclide[a]	Room Height = 2.5 m area= 200 m^2
H-3	3.58E+09
Pm-147	3.83E+07
Pb-210	2.22E+04
Ra-226	3.83E+03
Ra-226 + Pb-210	3.26E+03
Ra-228	4.11E+03
Th-228	1.59E+03
Th-232	5.29E+02
Th-232 + Ra-228 + Th-228	3.62E+02
U-234	6.53E+03
U-235	6.17E+03
U-238	7.16E+03
U-239	2.02E+03

a) It was found that doses for Th-232 and Ra-226 were occurring at later times (other than time zero). Therefore, for Th-232 and Ra-226 it would be assumed that short-lived progeny (Ra-228 and Th-228 for Th-232 and Pb-210 for Ra-226) are in equilibrium at time zero. Dose from unit concentrations of progeny would be added to the parent nuclide to get the DCGLs. For Th-232+D (Th-232 + Ra-228 + Th-228) and Ra-226 + Pb-210), this assumtion would give the most conservative DCGLs.

b) Source of DCGLs is *Seneca Army Depot Activity License Termination and License Release Plan*, Argonne National Laboratory- Environmental Assessment Division, 2002, page 6-20,21.

Table 3-3
Gross DCGL Development
SEAD-48 Work Plan
Seneca Army Depot Activity

Radionuclide	Soil (pCi/g)[(2)]	Soil (pCi/g)[(2)]	$DCGL_w$ (dpm/100 cm^2)[(2)]	$DCGL_{emc}$ (dpm/100 cm^2)[(2)]	Activity Fractions[(3)]
Th-232	1.14	1.5	5.29E+02	1.06E+05	0.16
Ra-228	1.88	2.4	4.11E+03	1.35E+05	0.16
Th-228	2.44	2.9	1.59E+03	2.65E+05	0.16
Pb-210	7.1	26.3	2.22E+04	4.38E+06	0.1
Ra-226	0.343	0.38	3.83E+03	1.85E+05	0.1
U-234	263	341.9	6.53E+03	1.30E+06	0.1
U-235	22.3	24.5	6.17E+03	1.13E+06	4.40E-03
U-238	103	144.2	7.16E+03	1.40E+06	0.11
Th-230	1.52	1.7	2.59E+03	5.18E+05	0.1
Pa-231	2.02	4.8	6.46E+02	1.29E+05	4.40E-03
Ac-227	4.25	6.8	1.29E+02	2.58E+04	4.40E-03
Gross DCGL [(1)]	1.5	1.8	1747	230390	

1) The gross DCGL is found using equation 4-4 of MARSSIM and is expressed as:
gross DCGL = 1/(sum of (Activity Fraction/DCGL) for each isotope.

2) All DCGLs are from the Draft License Termination Plan developed by ANL or developed by Parsons following the guidance of the Draft LTP.

3) Activity Fractions are for naturally occurring materials and are from NCRP 94.

Table 3-4
Field Instrument Efficiencies and Minimum Detection Amounts
SEAD-48 Work Plan
Seneca Army Depot Activity

GAMMA RADIATION DETECTION:

Probe Type/ Instrument	Radionuclide	MDA (dpm/100 cm²)[1]				DCGL$_W$[2] (dpm/100 cm²)	DCGL$_{EMC}$[2] (dpm/100 cm²)	Flag Values[3] (cpm)
		Static (45 min)	Static (10 min)	Static (1 min)	Scanning			
3x3 NaI	Ra-226	790	2,500	7,900	87,000	3,800	190,000	7,800
Windowed FIDLER[5]		NA	500	1,600	18,000	3,800	190,000	3,100
3x3 NaI	Pitchblende Ore	790	2,500	7,900	87,000	1,800	230,000	8,100
Windowed FIDLER[5]		NA	500	1,600	18,000	1,800	230,000	3,100

RADON DETECTION:

Instrument	Radionuclide	MDA (pCi/L)[6]	Flag Value
Electret (i.e., E-Perm)	Radon	0.2 to 0.5	background

APLHA/BETA RADIATION DETECTION:

Probe Type/ Instrument	Radionuclide	Efficiency	Probe Area (cm²)	MDA (dpm/100 cm²)	DCGL$_W$[2] (dpm/100 cm²)	DCGL$_{EMC}$[2] (dpm/100 cm²)
Alpha Plastic Scintillator[7,9] (aka Phoswich)	U-238	0.15	75	8	7,160	1,400,000
Beta Plastic Scintillator[8,9] (aka Phoswich)		0.20	75	670	7,160	1,400,000
Alpha Floor Monitor[9]		0.15	425	2	7,160	1,400,000
Beta Floor Monitor[9]		0.20	425	5	7,160	1,400,000
Gieger-Mueller Probe[7,9]		0.20	12	450	7,160	1,400,000

1) Estimated based on Parsons Calculation Using the Methods of NUREG-1507.
2) DCGLs are from the "Seneca Army Depot Activity Draft License Termination and License Release Plan", ANL, January 2002.
3) Flag values are developed based on the DCGLs, activity fractions, and background values using the methods of NUREG-1507.
4) It should be noted that the static MDAs are below the DCGLs for the FIDLER, however the scanning MDAs are not. This will be compensated in the field by using the conservative flag value. All areas potentiall elevated above background will be further investigated. Additionally, measurements collected in the field will be supplimented with the use of alpha/ beta radiation detecting instruments.
5) Values presented are based on previous field experience using a closed energy window on the FIDLER with a range of 50-250 keV.
6) Basis: MARSSIM Table 6.10
7) Per MARSSIM Table 6.4,
8) Beta Scintillator MDA is estimated using MARSSIM and NUREG-1507
9) Flag values are to be set as twice the background level.

Table 3-5
Laboratory MDAs
SEAD-48
Seneca Army Depot Activity

SOIL

Radionuclide	Required MDA	Proposed Analysis Method	Proposed Method MDA for Analysis	Sample Quantity Required
Thorium 232	0.5	HASL 300	0.5 pCi/g	50 g
Thorium 230	0.5	HASL 300	0.5 pCi/g	w/Th-232
Uranium 238	1	HASL 300	0.5 pCi/g	50 g
Uranium 235 + 236	1	HASL 300	w/U-238	w/ U-238
Uranium 233+234	1	HASL 300	w/U-238	w/ U-238
Radium 226	1	EPA 903.1	1 pCi/g	200 g

WATER

Radionuclide	Required MDA (pCi/L)	Proposed Analysis Method	Proposed Method MDA for Analysis (pCi/L)	Sample Quantity Required
Thorium 232	1	HASL 300	1	1 Liter
Thorium 230	1	HASL 300	1	w/Th-232
Uranium 238	1	HASL 300	1	1 Liter
Uranium 235 + 236	1	HASL 300	1	W/ U-238
Uranium 233+234	1	HASL 300	1	W/ U-238
Radium 226	1	EPA 903.1	1	1 Liter
Total Uranium	1 ug/L	NA	1 ug/L	100 mL
Gamma Spectroscopy	10	NA	based on Cs-137	2 L
Radium 228	3	NA	3	1 Liter
Gross Alpha	5	NA	5	1 Liter
Radon 222	200	NA	200	2-40 mL vials

BUILDING MATERIAL

Radionuclide	Required MDA	Proposed Analysis Method	Proposed Method MDA for Analysis	Sample Quantity Required
Thorium 232	0.5	HASL 300	0.5 pCi/g	50 g
Thorium 230	0.5	HASL 300	0.5 pCi/g	w/Th-232
Uranium 238	1	HASL 300	0.5 pCi/g	50 g
Uranium 235 + 236	1	HASL 300	w/U-238	w/ U-238
Uranium 233+234	1	HASL 300	w/U-238	w/ U-238
Radium 226	1	EPA 903.1	1 pCi/g	200 g

Table 3-6
Instrument Check Sources
SEAD-48 Workplan
Seneca Army Depot Activity

Instument	Probe Model	Use	Check Source
Phoswich	Ludlum 43-1-1	Alpha/Beta Surveys	Th-230/Tc-99
FIDLER	Bicron G5	Gamma Surveys	Am-241/Depleted Uranium
Exposure Rate Meter	Bicron MicroRem	Health and Safety	Cs-137
3"x3" NaI	Ludlum	High-energy Gamma Surveys	Cs-137/Depleted Uranium
Floor Monitor	Ludlum 43-37	Large-area Alpha/Beta Surveys	Th-230/Tc-99
URSA Gamma Spectrometer	Alpha Spectra 012502C	Gamma Spectroscopy	Calibration Source A3-084 contains Cd-109, Co-57, Te-123m, Cr-51, Sn-113, Sr-85, Cs-137, & Co-60
GM Pancake Probe	Ludlum 44-9	Health and Safety	Cs-137/Tc-99

Table 3-7
Justification of Monitoring Well Placement
SEAD-48 Workplan
Seneca Army Depot Activity

Monitoring Well	Placement	Rationale
MW48-1	By Class I Igloo E0804	Monitoring wells will be located between the drainage ditch and the igloos to determine if contamination is present.
MW48-2	Downgradient	To determine if residual radioactive contamination, if present, is leaving the site
MW48-3	By Class I Igloo E0806	Monitoring wells will be located between the drainage ditch and the igloos to determine if contamination is present.
MW48-4	By Class I Igloo E0807	Monitoring wells will be located between the drainage ditch and the igloos to determine if contamination is present.
MW48-5	By Class I Igloo E0809	Monitoring wells will be located between the drainage ditch and the igloos to determine if contamination is present.
MW48-6	Downgradient	To determine if residual radioactive contamination, if present, is leaving the site
MW48-7	Upgradient	To provide site specific background data
MW48-8	Cross-gradient	To provide site specific background data

4.0 DATA REDUCTION, ASSESSMENT, AND INTERPRETATION

The data collected from the radiological screening surveys, direct measurement surveys, exposure rate surveys, removable radiation surveys, and the in-situ gamma surveys will be reduced, assessed and interpreted following the guidance in NUREG/CR-5849, NUREG 1505, and MARSSIM (NUREG-1575, EPA 402-R-97-016, September, 2000). These data will be used to compare the SEAD-48 data to background/reference data using the Wilcoxon Ranked Sum test and/or the Quantile Test following the guidance provided in NUREG 1505, MARSSIM (NUREG-1575, EPA 402-R-97-016, September 2000), and the EPA's Statistical Methods for Evaluating the Attainment of Cleanup Standards. These tests, as well as statistical graphs of the site and reference data (which may include histograms, quantile plots, power curves, etc.), and basic statistical quantities (such as the mean, standard deviation, median, maximum, and minimum values of the datasets) will be used to illustrate the conditions at SEAD-48 as compared to one or more background / reference areas and to show that the survey comply with final status survey requirements.

5.0 DATA REPORTING

The data from the radiological surveys will be presented in a format which provides the calculated surface activity or radionuclide concentration value, the estimated confidence level for that value and the estimated MDC for the measurement, as detailed in NUREG/CR-5849. All data shall be subject to verification and validation prior to use in the final report, including consideration of technical validity.

6.0 STAFFING

A field crew consisting of a Health Physicist and two crewmembers will be working on site at SEAD-48. All field personnel working on site will have received a minimum 1-hour of radiological safety and fundamental training, as well as a minimum of 24 hours of onsite orientation and technique training. This will include briefing on the risk associated with uranium, thorium, and their progeny, including radon. A Health Physicist/Radiological Safety Officer (HP/RSO) will oversee all radiation scanning work onsite. All onsite workers will have current 40-hour OSHA HAZWOPPER Certification.

7.0 SCHEDULING

The execution of this work is scheduled as follows:

Activity	Scheduled Due Date/Performance Period
Field Activities	April 1, 2003 through June 30, 2003
Draft-Final Status Survey (FSS) Report	September 1, 2003
Agency Comments	September 30, 2003
Draft Final - FSS Report and Comment Responses	November 14, 2003
Agency Comments	December 14, 2003
Final - FSS Report and Comment Responses	January 28, 2003

APPENDIX A

Assessment of the Contamination Status of the EO800 Row Storage Bunkers at the SEAD, Argonne National Laboratories, November 2001.

ASSESSMENT OF THE CONTAMINATION STATUS OF THE E0800 ROW STORAGE BUNKERS AT THE SEAD

INTRODUCTION

This paper assesses the contamination status of a row of 11 ammunition bunkers numbered from E0801 to E0811 at the Seneca Army Depot (SEAD). The purpose of this assessment is to chart a path forward for the eventual release of the bunkers, which will, by all indications, involve further surveys. This assessment will help identify the areas that may require further decontamination and establish the appropriate stringency of the needed final status surveys in accordance with the survey unit classification levels defined in the MARSSIM guidance.

Some of these bunkers had been used to store 1823 barrels of high-grade pitchblende ore for a short period during the Manhattan Project in the 1940's. Pitchblende ore is rich in the radioactive elements uranium, radium, and thorium. The ore was removed over the course of three months and the bunkers used for the most part for non-radiological storage. Two of the bunkers, E0801 and E0802, were later used to store depleted uranium munitions and are listed under NRC licenses SUC-1275 and SUC-1380. These two licenses are currently undergoing termination or release activities. The Department of Energy discovered residual contamination in the bunkers in 1976 (DOE 1979), during characterization performed the radiological status of the bunkers resulting from the storage of pitchblende in the 1940's. Since that discovery, a number of cleanup and survey activities have been conducted in and around the bunkers. The history of 800 row surveys is summarized below.

PAST SURVEYS

The following summaries are presented for the purpose of compiling previous survey information at the beginning of this analysis so that the contamination status of the bunkers can be readily evaluated in later sections. Accordingly, the surveys are not evaluated in this section in terms of technical quality or sufficiency in terms of present day requirements, but rather are presented in simple chronological order. The surveys are summarized from reports, memos, and letters that are not comparable in level of detail or documentation. However, general information was often available on survey instruments, methods, sample locations, and results and is summarized in Table 1.

September 1976 DOE survey (U.S. DOE 1979). A three-member team from Oak Ridge National Laboratory performed surveys of all 11 E-0800 row bunkers during the period September 10-23, 1976. Surveys included (1) direct readings and (2) swipes of gross alpha and beta activity on surfaces throughout each bunker, (3) gamma exposure rates inside and outside the bunkers, (4) isotopic analysis of uranium and related radionuclides in soils near the bunkers, (5) radon and radon daughters in the air inside the bunkers, (6) radioactivity in surface water near the bunkers, and (7) radioactivity along the rail spur and loading docks where pitchblende ore was handled.

Table 1. Summary of Historical E0800-Row Surveys

Survey	Survey Methods	Bunkers with Interior Contamination	Bunkers with Exterior Contamination	Maximum Interior Levels	Maximum Exterior Levels
September 1976 DOE MED/AEC survey of Bunkers E0801-E0811, rail spur and docks	Interior -direct and removable alpha, beta, gamma, radon; Exterior - gamma rates, U, Ra in soil, water	E0804-E0811; U-238, Ra-226, radon	E0804-E0811; near entrances, gamma rates, U-238, Ra-226	130,000 dpm/100cm^2 direct alpha in drain trough in E0804	7,820 pCi/g Ra-226 in surface soil outside E0804
October 1980 FBDU survey of Bunkers E0801-E0811	Interior- spot checks of alpha, beta, radon, and gamma rates; Exterior- 33 soil borings to 1 foot, gross alpha, Ra-226, and radon flux surveys	E0804-E0811; E0804 and E0806 exceeded NRC surface release criteria for uranium	E0804-E0811	0.69 WL Radon in E0804, 20 R/hr in E0810, E0811; 6000 dpm/100 cm^2 alpha in E0806;	3.2 pCi/g Ra-226 outside E0807, 6.0 pCi/g U-238 outside E0806
May 1985 RADCON Survey of Bunkers E801-E0811, and rail spur and docks (pre-Decon; two survey teams)	Interior- gamma rates. 25 direct alpha and alpha smears, radon; Exterior- gamma surveys, soil and water samples by gamma spec	E0804- E0811; U-238, Ra-226 and daughters	E0804, E0805, E0806, E0808, E0810, and E0811; U-238, Ra-226	>5,000 dpm/100 cm^2 in E0804, E0806; 250 R/hr in E0804; 12,000 pCi/g Ra-226 in internal drain in E0804	1033 R/hr on E0804 pad; 2,400 pCi/g U-238 in E0804 soil
June 1985 pre-Decon Survey of Bunkers E0802 - E0811 (not E0801)	Interior- gamma rates over floors; Exterior- germanium gamma spec on soils	None of the Interiors of the 10 bunkers were above background	E0804, E0811	Background levels in all 10 bunkers	4.000 R/hr in soil outside E0804
July 1985 Decon Survey of Bunkers E0801-E0811	Continuous survey maps of cleanup areas, 36 post cleanup soil, 120 shipping container, and 300 workplace monitoring samples	Not specified	Outdoor areas of 8 unspecified bunkers	Not specified	All 36 soil samples had residuals of Ra-226 and U-238 less than 5 pCi/g

Survey	Survey Methods	Bunkers with Interior Contamination	Bunkers with Exterior Contamination	Maximum Interior Levels	Maximum Exterior Levels
July 1985 AEHA Closeout Survey of Bunkers E0801-E0811	Interior-Surface alpha and beta, gamma rates; Exterior- alpha and beta survey; gamma rates; alpha, beta, gamma levels in soil samples	E0804, E0806, E0808, E0809	E0804, E0806	2000 cpm direct alpha in E0808, 500 cpm direct beta in E0804, 47 dpm/100 cm^2 removable alpha in E0804	150 R/hr in gravel/tar area outside E0804; 50 pCi/g gross alpha near E0806; 43 pCi/g gross beta near E0804
October 1987 NRC Closeout Inspection of Bunkers E0801-E0811	Interior- direct and swipes of alpha and beta; gamma rates; Exterior-gamma rates, 2 soil and 1 water sample	None	None	Background levels	Background levels
June 1993 NYSDEC Inspection of E0802, E0804, E0806, E0808, E0809, and E0710	Interior- spot beta and gamma surveys; swipes (E0804, E0806); Exterior-beta and gamma surveys; Soil near E0804 and E0808	Several areas inside E0804 and one drain in E0808	E0804, in and around the outside drains on the North side	40 R/hr, 77 dpm/100 cm^2 alpha removable in E0804; Ra-226 (87 pCi/g), U-238 (83 pCi/g) in E0808 drain	106 R/hr, outside drain, North wall, East side of E0804

Bunker interiors were typically divided into 16 floor, 16 wall/roof, and 4 end sectors for surveys of gross alpha and beta activity on surfaces. Portable gas proportional counters were used for direct gross alpha measurements and Geiger-Mueller (G-M) meters for beta-gamma activity. Smears were counted in the field using a zinc-sulfide scintillator for alpha, and a G-M tube for beta activity. A sodium 3"x3" sodium iodide detector was used to measure gamma exposure rates. Radon and daughters were determined using a Lucas Chamber, while soil samples were analyzed for uranium and radium isotopes by laboratory gamma spectrometry. Surface water was also analyzed in the laboratory, in this case using a sequential separation method.

Surface measurements in E0801, E0802, and E0803 were indistinguishable from background (Bunker C0912). Bunker E0804 exhibited the highest direct surface alpha readings, up to 130,000 disintegrations per minute (dpm)/100cm^2 near a wall-floor corner. Bunkers E0804-E0808 exhibited similar patterns of contamination at somewhat lower levels, while Bunkers E0809-E0811 had even lower, but still elevated levels of contamination. Exterior surfaces near the roof vents of all bunkers also showed low-level alpha contamination. Levels were similar to those measured in the A0800 row, some 4 miles away.

Radon levels were elevated in all bunkers except E0801, E0802, and E0803, ranging as high as 6.4 pCi/L in E0809. Interior gamma exposure rates were generally similar to the background level of 10   R/hr, with levels approaching 20   R/hr in Bunkers E0810 and E0811. Exterior gamma levels were at background levels except within 15 feet of bunker entrances where readings were slightly elevated (up to 31   R/hr near E0806) for all bunkers except E0801, and E0802. Gamma exposure rates measured on loading Dock 305 and Dock 600 and along adjacent rail tracks were at background levels. Readings of 15 R/h r in a drainage ditch near Dock 600 were attributed to shale outcroppings in the vicinity.

A total of 22 surface soil samples (0-12 inches deep or less) were collected near the entrances of the bunkers and one interior drain trough sediment in E0804 was taken. Samples were analyzed at Oak Ridge for several isotopes including U-238 and Ra-226. Isotope levels near bunkers E0801-E0803 were at background. Levels were highest outside E0804, with one sample at 7820 pCi/g for Ra-226. Levels outside the other bunkers were much lower, but still elevated. The drain trough inside E0804 had 46,300 pCi/g Ra-226 and 67,070 pCi/g U-238. Surface water sample results for uranium, radium and thorium isotopes were more than an order of magnitude below maximum permissible concentrations (10 CFR Part 20, Appendix B).

May 1981 Monsanto Estimate of Ra-226 Levels in Bunker E0804 (Monsanto May 1981).
Monsanto staff at the Mound facility in Ohio performed estimates of Ra-226 levels in E0804, assumed worst-case at the SEAD, using two methods. Both methods required gross assumptions, but were expected to bracket the actual value. The first method used a back-calculation of radium from measured radon levels in air. This estimate was assumed to be biased low due to incomplete release of radium from surfaces and disequilibrium with progeny due to removal of radon gas. This method produced an estimate of 2.8   C i total in E0804. The second method involved estimating Ra-226 activity from gross alpha readings on surfaces. The estimated 14.5 Ci Ra - 226 was expected to be high as it assumed all alpha activity was due to Ra-226. The true value was expected to lie between 3 and 15   C i Ra-226.

October 1980 Ford Bacon&Davis Utah (FBDU) survey (FBDU 1981). Characterization of the E0800 row bunkers was performed to support the development of a preliminary engineering and environmental evaluation of remedial action alternatives for cleanup of the bunkers under the FUSRAP program. The evaluation relied on the 1976 ORNL data as a baseline characterization and supplemented this data with additional soil surveys and confirmation of surface contamination levels. No water samples were taken. Soil sampling was performed to establish excavation boundaries and soil volumes to be used in the evaluation of action alternatives. Surveys also included radon measurements inside bunkers, gamma exposure rates inside and outside bunkers, and spot checks of direct and transferable alpha contamination on interior surfaces.

Radon levels inside and gamma exposure rates inside and outside bunkers measured by FBDU were comparable to levels in the ORNL survey, with maximum measured levels of 0.048 WL (working level) and 0.069 WL (in E0804), respectively. The occupational standard in effect at the time was 0.015 WL. Radon flux outside and near the bunker entrances as measured by FBDU were as high as 2.1 pCi/m2-s outside E0803, which was above the criterion for soil covers in 10 CFR 40, Appendix A. Radon flux levels varied little from bunker to bunker.

Spot checks of direct surface readings and swipes confirmed the absence of surface contamination in bunkers E0801-E0803. All other bunkers had elevated surface levels. E0804 and E0806 had levels in excess of NRC release guidelines for natural uranium in effect at the time.

Soil sampling and surveys were conducted for the purpose of concisely delineating excavation boundaries against a 5pCi/g-action level for Ra-226. Three soil borings to a depth of 12 inches were taken near each of the 11 bunkers and each sampled at 0-6 inches and 6-12 inches for a total of 33 borings and 66 samples. Borings were taken across the access road, just east of the entrance and on the east side and half-way down each bunker. FBDU also performed gross alpha and Ra-226 surface surveys to delineate contamination. Results confirmed the earlier ORNL surveys, established that there was no contamination on the north side of the access road, and established that contamination was very much confined to the areas immediately outside bunker entrances. In many instances, background levels were just a few feet away from the locations of the highest level samples in either survey.

The area exceeding the 5 pCi/g Ra-226 action level outside each bunker was determined by interpolating results spatially from samples above and below that level. The total area identified for excavation outside bunkers E0804-E0811 was 279 m2. The maximum depth of contamination was established to be 1.5 feet, as bedrock shale was encountered at a depth of 1 foot in borings. This depth equated to an estimated total excavation volume of 127 m3. The evaluation further concluded that remedial actions would also have to include decontamination of surfaces in Bunkers E0804 and E0806 that exceeded NRC release criteria.

May 1985 Army RADCON survey (U.S. Army 1986). Two separate RADCON units performed surveys of direct alpha and beta surface contamination, removable alpha and beta contamination, interior and exterior gamma radiation levels during the week of 13 May 1985. The units also determined uranium levels in surface soil and water in the vicinity of the bunkers, performed air monitoring for radon and radon daughters, and measured activity levels along the rail spur and loading dock used to transport the ore. The survey units used a Ludlum 2220 FIDLER for low-energy gamma detection, a Ludlum Model 3 Pancake G-M meter for beta and low-energy gamma detection, a Ludlum Model 19 microR meter for high-energy gamma, a PAC-1SA gas proportional counter for alpha particle detection, and Canberra 2401 or Eberline Models AC-4 and BC-4 for counting removable alpha and beta on smears, respectively.

Soil samples were collected from representative areas near each building with elevated gamma dose rates. The top one-inch of soil over one square foot was collected. Water samples were collected from standing or running water when present near any building. A water sample was also taken from a drainage channel along one wall inside E0804.

The first team performed systematic surveys of bunker interiors along 5 survey lines running across the bunkers starting one meter from the back wall and spaced 6 meters apart. Continuous scans were taken along the lines with the FIDLER and MicroR meters. Four direct readings, two from floor and two from the wall/ceiling, were also recorded using the FIDLER, Model 3, PAC 1SA, and micoR instruments along these lines. Smears were taken at the same locations. The spaces between the 6-meter survey lines were scanned at 2-meter intervals using the FIDLER and microR meter. The second team performed a similar, but not identical, survey immediately following the first survey.

Interior surfaces of bunkers E0804 through E0811 were found to be contaminated with natural uranium and its daughters. This identification was apparently based on analysis of sediment samples taken from interior drains that were analyzed by germanium gamma spectrometry. These drain samples showed elevated activity in all bunkers except E0801, E0802 and E0808 (E0803 and E0811 drain samples had only marginal activity). Direct surface measurements of alpha activity exceeded the NRC guideline of 5000 dpm/100 cm^2 in some areas of E0804 and E0806, while no samples exceeded the 1000 dpm/100 cm^2 guideline for removable activity.

Bunkers E0804 and E0811 had large contaminated areas outside the entrances. The area outside bunker E0804was surveyed in detail over a grid. Exposure rates ranged as high as 1033 R/hr, while soil samples had concentrations as high as 2400 pCi/g U-238 and 1590 pCi/g Ra-226. The water sample taken from the drain inside E0804 showed barely detectable activity. The outdoor concrete surfaces around the entrances of E0804, E0805, E0806, E0808, E0810, and E0811 all had elevated readings. Surveys of the railway spur and the loading area showed no elevated activity in either area.

June 1985 log of R. Bhat of preparations for health physics support for the SEAD cleanup (U.S. Army, June 1985). This report logs preparation activities performed by the U.S. Army Belvoir R&D Center in advance of the E0800 row cleanup for the period March-April 1985. The entry for March 17, 1985 notes that the decontamination limit in effect for soil was 5 pCi/g and for air was 20 R/hr, consistent with EPA requirements under 40 CFR 192.12. The entry further notes that cleanup personnel would receive a baseline lung count prior to the action.

June 1985 on-site lab setup and pre-decon bunker survey (U.S.Army, July 1985). Belvoir R&D Center (BRDC) and SEAD personnel set up and checked out portable equipment for upcoming surveys in support of cleanup activities. Two Reuter-Stokes RSS-111 pressurized ionization chambers (PICs), a Canberra Series 10 germanium detector/MCA, and a Ludlum 19 G-M detector were tested. Clean soil from the site was tested against BRDC soil standards (NBS, now NIST, traceable). Clean soil measured 1.5 pCi/g; the EPA soil limit cited was 5 pCi/g. Background exposure rate measurements taken in Building 321 using the PICs averaged 8.3 R/hr.

Bunkers E0802-E0811 (formerly numbered 2047, 2049, 2051, 2053, 2055, 2057, 2059, 2061, 2063, and 2065) were surveyed using the PICs at 1-meter height and along the inside perimeter using the Ludlum 19 G-M detector. All interior readings fell between 7-11 R/hr. This was similar to background and well below the EPA standard of 20 R/hr over background. Exterior measurements made within 3 meters of the entrance at 1-meter height ranged from 57 R/hr to 4,000 R/hr. The highest values were outside E0804 (Bunker 2051).

July 1985 decontamination activity log (U.S. Army, August 1985). Mr. Funkhouser (BRDC) and six SEAD radiation workers decontaminated interior surfaces and removed contaminated soil, concrete and asphalt from entryways of bunkers. The log entry for the third week of April 1985 affirmed that the cleanup standards in effect were 5 pCi/g Ra-226 in soil and a gamma exposure rate 20 R/hr above ambient levels. During the third and fourth weeks of July, workers scraped, abraded, and vacuum blasted contaminated floors, gutters, and interior surfaces inside the bunkers. Using chisels, shovels, jackhammers, and a backhoe, contaminated soil, concrete, and asphalt, was removed from entryways. Nearly 90 tons of material were excavated from 15 sites at 8 bunkers and placed in thirty B25 shipping containers.

Continuous field surveys were performed to map contamination during removal. Over 300 samples were collected for analysis of U-238 and Ra-226 in soil, air filters, nasal wipes, airhats, shipping containers, and equipment. Thirty-six soil samples analyzed in an on-site laboratory showed residuals of less than 5 pCi/g of U-238 and Ra-226, IAW with federal regulations. 120 samples taken from the thirty B-25 containers showed less than 22 dpm/100 cm^2, IAW 49 CFR..

July 1985 U.S. Army Closeout Survey of Bunkers E0801-E0811 (U.S. Army, December 1985). The U.S. Army Industrial Hygiene Agency (AEHA), Aberdeen Proving Ground, MD, conducted sampling of the E0800 row bunkers during 29-31 July 1985 to determine if cleanup actions had been effective. Surveys of bunker interiors included direct measurements on surfaces of gross alpha and gross beta activity, gamma exposure rates at 1-m above floor height, and gross alpha and beta activity on surface swipes. Samples taken outside of bunkers included gross alpha, gross beta activity, gamma exposure rates, and discrete soil samples. Field instruments used included a MicroR meter for gamma exposure rates, and alpha scintillation probe and counter for alpha activity, and a Geiger-Mueller meter for gross beta/gamma activity.

A total of 264 swipe samples were collected in the 11 bunkers, averaging 24 per bunker, evenly distributed over the floor and lower walls of the bunkers. The maximum gross alpha reading was 47 dpm/100 cm^2 (2.1E-5 Ci/100 cm^2) in bunker E0804, located center-left on the floor. The maximum beta reading was 80 dpm/100 cm^2 (3.6E-5 Ci/100 cm^2) in E0804 at the same location that had the highest direct gamma and beta readings, just back of the alpha swipe maximum.

A total of 46 direct readings of gross alpha and beta were taken on surfaces in the 11 bunkers. A gamma exposure rate measurement was taken at each of the same locations. The highest alpha activity was 2,000 counts per minute (cpm) measured in E0808 on the floor, right and rear of center. E0806 had levels ranging from 50-300 cpm, while E0809 had a single elevated reading of 50 cpm. No other bunker had a direct alpha reading over 3 cpm. Background for interior alpha was 0 cpm. Activity in dpm would be obtained by dividing readings in cpm by instrument efficiency, which was not provided. Typical efficiencies of alpha scintillators (ZnS) are on the order of 20%. Thus, levels in dpm would be roughly 5 times these values.

The maximum direct gross beta reading was 400-500 cpm in E0804 near the alpha maximum. At a typical beta efficiency of 33%, this equates to 1200-1500 dpm. Background for interior beta was 0-5 cpm. Interior gamma exposure rates were limited to a maximum of 15 R/hr detected in Bunkers E0804 and E0805, versus a background level of 10 R/h r.

Instrument surveys of the grounds outside the bunkers found that gross alpha and beta readings (32 readings each) were all at background levels. All of 32 gamma readings taken at the same locations were near the 10 R/hr background level except at one location. A very localized area outside Bunker E0804 exhibited a reading of 150 R/hr in a gravel and tar area. This location was outside the perimeter of the excavated area around the entrance to the bunker. Apparently, because of its localized nature, no remedial action was recommended for this area. Figures in Appendix J show the outlines of excavated areas. Areas of varying, but limited, size outside Bunkers E0804-E0811 were excavated to a depth of between 0.5 and 4 feet. E0804 had the greatest volume of soil removed with excavation to a depth of 3-4 feet about the entrance pad.

Fourteen soil samples were collected outside the entrances of the 11 bunkers and analyzed for gross alpha, beta, and gamma activity. The highest alpha activity recorded was 5E-5 Ci/g (50 pCi/g) near E0806, while the highest beta reading was 4.3E-5 C i/g (43 pCi/g) outside E0804. Average readings were roughly half these values. The highest gamma reading for these samples was 6.2E-6 Ci/g (6.2 pCi/g) for Pb-214 outside E0806. All gamma readings were within the range of normal background.

On the basis of the above results, the Army report concluded that decontamination activities had rendered the 11 bunkers and surrounding areas in conformance with the requirements for unrestricted use and that the bunkers should no longer be identified as a contaminated area. The report, however, did not explicitly mention the specific cleanup criteria in effect upon which these determinations were made, nor were survey readings compared to any standard cleanup criteria other than background that might have been in effect at the time.

October 1987 NRC Closeout Inspection No. 87-002 (NRC 1988). Two NRC staff members conducted an inspection of the E-0800 row bunkers on October 29, 1987. The inspection consisted of visual observations of the bunkers, interviews with site personnel, spot examination of records, and selected measurements of radioactivity in and around the bunkers. Twenty-seven swipe samples were analyzed for removable alpha and beta activity, selected areas were subjected to direct surface measurements, and two soil and one water sample were analyzed for gamma activity.

Gamma radiation levels were measured with a Micro-R meter; background levels were 12 R/hr, similar to other surveys. Swipe samples were analyzed in the NRC Region I laboratory using a Tennelec proportional counter with minimal detectable activities (MDAs) of 24 dpm beta and 3 dpm alpha. Soil and water samples were analyzed by germanium gamma spectrometry in the same laboratory.

No gamma levels above background level were found in measurements made in and around the bunkers. None of the 27 floor swipes had readings above MDAs for alpha or beta activity. Gamma spectrometry results for a water and a soil sample, which were taken on the east side of the E0804 pad where soil had be removed, showed no identifiable gamma peaks. A second soil sample taken from the pad area of E0804, showed only environmental levels of identified radionuclides.

On the basis of these results, the NRC concluded in their May 2, 1988 report that Bunkers E0801-E0811 could be released for unrestricted use.

June 1993 NYSDEC Bureau of Radiation Protection inspection survey (NYS DOH 1993). NYSDEC and NYSDOH staff inspected three areas, Buildings 324, 356 and 357; storage bunkers E0801-E0811; Building 803; and Bunker E0710 (background location). Instruments used were a Ludlum MicroR meter, Model 12S, Ludlum Model 3-98 with internal G-M probe and external NaI probe, and an Eberline E-120 G-M meter. Gamma measurements were performed in selected areas with the MicroR and Model 3-98 instruments. Beta readings were taken with the G-M meter.

The NYSDOH report concluded that, based on inspection results, several areas of contamination inside and outside of Bunker E0804 and one hotspot inside of E0808 require further remediation. No other readings deviated significantly from background. Contamination in E0804 was found along the concrete drainage ditch, in the outside drains on the north wall 1-2 feet above ground level, and in the soil around the drains. Readings inside E0804 ranged as high as 40 R/hr and 400 cpm beta, compared to a background level of 8-10 R/h r in E0710. Soil near the north wall, east side, outside E0804 had readings of 106 R/hr and 1800 cpm at a depth of 4-6 inches. The E0808 hotspot is in a drain, which contains elevated levels of U-238 (83 pCi/g), U-235 (11 pCi/g), and Ra-226 (87 pCi/g).

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APPENDIX B

Seneca Army Depot Activity License Termination and License Release Plan- Draft, Argonne National Laboratories, January 2002.

Seneca Army Depot Activity
License Termination and License Release Plan

U.S. Department of the Army,
Seneca Army Depot Activity, New York

prepared by
Argonne National Laboratory
Environmental Assessment Division
Argonne, Illinois

January 2002

CONTENTS

TABLES

FIGURES

Notation

The following is a list of the acronyms, abbreviations, and units of measure used in this report:

Acronyms and Abbreviations

AEC	U.S. Atomic Energy Agency
ALARA	as low as reasonably achievable
Am	americium
AMCCOM	Armament, Munitions and Chemical Command (U.S. Army)
BRAC	Base Realignment and Closure
CFR	*Code of Federal Regulations*
D&D	decontamination and decommissioning
DCGL	derived concentration guideline level
DOA	U.S. Department of the Army
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQI	data quality indicator
DQO	data quality objective
DSR	dose-to-source (concentration) ratio
DU	depleted uranium
EPA	U.S. Environmental Protection Agency
H-3	tritium
LTC	Lieutenant Colonel (U.S. Army)
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	minimum detection activity level
NaI	sodium iodide
NRC	U.S. Nuclear Regulatory Commission
Pm	promethium
Pu	plutonium
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control

Ra	radium
SEDA	Seneca Army Depot Activity
Sm	samarium
Tc	technetium
TEDE	total effective dose equivalent
Th	thorium
U	uranium

Units of Measure

cm	centimeter(s)
cm^2	square centimeter(s)
cm^3	cubic centimeter(s)
cpm	count(s) per minute
d	day(s)
dpm	disintegration(s) per minute
g	gram(s)
h	hour(s)
keV	kiloelectron volt(s)
kg	kilogram(s)
L	liter(s)
m	meter(s)
m^2	square meter(s)
mm	millimeter(s)
mrem	millirem(s)
pCi	picocurie(s)
s	second(s)
yr	year(s)

1 GENERAL INFORMATION

The purpose of this License Termination Plan (LTP) is to successfully terminate Nuclear Regulatory Commission (NRC) license #SUC-1275 (Docket No. 040-08526) held by the Department of the Army (Seneca Army Depot Activity, 5786 State Route 96, Romulus, New York 14541-5001) and to amend, gain release from, or otherwise close out the following licenses and permits:

- SUC-1380, Possession and Storage of depleted uranium as 25 mm, 105 mm, and 120 mm cartridge penetrators, issued to U.S. Army, Operations Support Command (OSC).
- 45-16023-01NA issued to US Navy for 20 mm and 25 mm cartridges.
- SUB-834 held by U.S. Army Combat Systems Test Activity for 7.62 mm and 0.50 caliber cartridges
- BML 12-00722-07, possession of promethium-147 in the light anti-tank rocket system
- STC-133, to store Columbite and tantalum (thorium) ore, managed by Defense Logistic Agency

Seneca Army Depot Activity (SEDA) is located about 40 miles south of Lake Ontario, near Romulus, New York. The 10,587-acre SEDA facility was constructed in 1941 and has been owned by the U.S. Government and operated by the Department of the Army (DOA) since that date. From its inception in 1941 until 1995, SEDA's primary mission was the receipt, storage, maintenance, and supply of military items, including munitions and equipment. The Depot's mission changed in 1995 when the Department of Defense (DOD) recommended closure of the SEDA under its Base Realignment and Closure (BRAC) process. The above NRC license-related activities occurred in the following buildings/structures:

- Building 612
- Building 5
- Building 306
- Building S-2084
- Building 2073

- Warehouse 356

- Total of 121 ammunition storage bunkers

In addition to the buildings covered directly under the license, and in accordance with NRC's July 26, 2000 letter to this effect, the entire site will be evaluated to determine that it meets Radiological Criteria for License Termination specified in CFR 20.1402 and applicable State criteria. This evaluation will include a review of any facilities previously released for unrestricted use and any facilities or areas currently undergoing cleanup. Historical survey records will be reviewed from previously released areas to evaluate whether they meet current release standards, while other ongoing radiological cleanups will be coordinated with license termination activities.

This LTP describes the process to be used in meeting the requirements for terminating, gaining release from, or amending the affected NRC licenses. Section 2 reviews the building histories and the results of past characterization activities. On the basis of this review it is expected that no decontamination would be required. If, during the final status survey, it were found that some areas are above the release criteria, those areas would be remediated to acceptable levels (Sections 3 and 4). Section 5 describes the Final Status Survey Plan, which is consistent with the guidelines of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, NRC 1997). Section 6 together with Section 5, describes the process for demonstrating compliance with the radiological criteria of Title 10, *Code of Federal Regulations,* Part 20.1402 (10 CFR 20.1402) for unrestricted future use for the affected buildings and structures.

2 HISTORY AND CHARACTERIZATION

Activities at the SEDA included storage and maintenance of radioactive commodities. The Army radioactive commodities at the site were mainly depleted uranium (DU) munitions. These commodities were used, stored, and maintained under the various licenses issued to the Army by NRC as listed in Section 1. Army radioactive commodities are ruggedly designed and contain a limited amount of radioactivity, which is typically in a nondispersible form. Commodities are not expected to have released contamination in areas where they were stored or handled.

2.1 Historical Site Assessment

A complete review of available records and files for the buildings included under the various license termination and release activities was conducted in 1999 and 2000. None of the inspection reports, survey data, or employee discussions indicated any accidents or incidents involving the commodities, either licensed or unlicensed. The periodic radiological surveys conducted by the Army in accordance with the licenses did not show any areas of concern. This review revealed the following facts:

- The SEDA was established in 1941 as an ammunition and general supply depot.

- During the 1940s, the SEDA stored barrels of pitchblende ore in 11 ammunition storage bunkers (E0801-E0811). In the 1980s, those bunkers were surveyed and remediated to allow unrestricted use (NRC 1988). Survey results showed no elevated readings for E0801 and E0802, the two bunkers included in this LTP (U.S. Army 1986).

- In the early 1950s, the Atomic Energy Commission (AEC) built and operated a special-weapons storage and maintenance facility on the north end of the Depot. In 1956, those facilities were taken over by the U.S. Army and were fully functional until 1993. The 64 special-weapons storage bunkers (A0101, A0102, A0201-A0218, A0301-A0317, A0401-A0409, A0501-A0508, and A0601-A0610) were surveyed in 1992 and 1993 and were released for unrestricted use. The remaining special weapons facilities are currently being surveyed for possible contamination as the part of the Army's environmental remediation program.

- Under license BML 12-00722-07, storage bunker A0701 was used to store light anti-tank rockets, with rocket sights containing promethium-147. The promethium-147 is contained in ceramic microspheres, mixed with self-luminous paint, and laminated between plastic sheets to provide illumination of the 100- and 150-yard markings in the front aiming sight according to the license application (U.S. Army 1997), the promethium-147 cannot escape unless the sight is subject to crushing, melting, or breaking across either the 100- or 150-yard markings. That scenario was considered unlikely.

- Warehouse 356 was used to store Columbite and tantalum ore containing thorium. NRC released the building for unrestricted use under Amendment 16 to STC-133 on December 22, 1994. Results of a June 10, 1993, New York State Department of Environmental Conservation (NYSDEC) survey of Warehouse 356 showed no significant deviations from background (Baker 1993). The interoffice memo in which the results are reported also noted that the Columbite ore (5,284 drums) had been transferred to a facility in Binghamton, New York, approximately 2 weeks prior to the survey date. It further noted that the Army had plans to clean the building with a HEPA filtered vacuum system and that all areas where the ore had been stored were surveyed, and wipes were taken for analysis.

- License SUC-1275 involved the use of five buildings (612, 5, 306, S-2084, and 2073) and 120 ammunition bunkers:

  - *Building 612* was used primarily as a point to unpackage, inspect, and repackage DU ammunition. License SUC-1275 also permitted demilitarization of munitions in Building 612, although this activity was never initiated. That activity would have involved mechanical separation of munitions. The license expressly directs that no cutting, grinding, or metallurgical processes were to be performed on DU. Building 612 underwent an extensive survey for release in 1999. Survey readings were very low. None approached the dose-based release limits used at the time of the survey. However, release limits have since been revised downward using revised inputs to the dose-model used (RESRAD-BUILD). Building 612 survey data will be reevaluated against the revised limits. Building 612 is proceeding directly to a Final Status Survey Report for release.

  - *Buildings 5, 306, S-2084, and 2073* were used as staging points to prepare the DU ammunition for shipment.

  - *120 ammunition bunkers* were only used to store packaged DU ammunition. Periodic surveys of these structures were conducted when DU ammunition operations were being conducted. No elevated levels of radioactivity were ever detected. The last of the depleted ammunition was shipped off the Depot by September 1999. Table 2-1 lists the affected bunkers.

Table 2-1
List of 121 Storage Bunkers under NRC Licenses[a]

A0201	B0109	C0203	D0104	E0103
A0316	B0411	C0303	D0105	E0105
A0317	B0501	C0307	D0107	E0112
A0508	B0602	C0308	D0108	E0211
A0701[b]	B0603	C0401	D0110	E0301
A0706	B0609	C0403	D0113	E0302
A0707	B0610	C0405	D0206	E0303
A0710	B0701	C0406	D0207	E0312
A0711	B0705	C0407	D0305	E0402
A0901	B0707	C0408	D0306	E0410
A0905	B0708	C0501	D0312	E0411
A1108	B0709	C0503	D0401	E0413
A1109	B0711	C0504	D0406	E0504
	B0801	C0505	D0407	E0506
	B0802	C0508	D0413	E0508
	B0804	C0510	D0601	E0510
	B0809	C0511	D0604	E0512
	B0810	C0513	D0607	E0602
	B0811	C0603	D0704	E0604
	B0909	C0604	D0705	E0609
		C0605	D0711	E0610
		C0606	D0712	E0702
		C0608	D0801	E0706
		C0701	D0805	E0711
		C0706		E0801
		C0707		E0802
		C0708		
		C0801		
		C0803		
		C0807		
		C0809		
		C0901		
		C0902		
		C0906		
		C0907		
		C0908		
		C0909		
		C0912[c]		

See footnotes on next page.

Table 2-1 (Con't)

[a]Except as otherwise indicated, bunkers were used for storage of packaged DU ammunition under SUC-1275.

[b]A0701 was used for storage of light anti-tank rockets containing promethium-147 under BML 12-00722-07.

[c]Bunker C0912 is a control bunker to establish radiological background levels.

2.2 Initial Area Classification

Historical site assessments were conducted to identify buildings and other structures, as well as land areas affected by the licensed activities, where radioactive commodities were stored or repaired. A review of the type of operation, as well as any accident/incident/leak test reports, was considered in the classification of areas. On the basis of the available historical information, areas under the license were divided into impacted and nonimpacted areas according to the criteria identified in MARSSIM (NRC 1997). Nonimpacted areas have no reasonable potential for residual contamination and therefore would not be included in the survey effort except to establish background levels. Impacted areas have some potential for containing residual radioactivity and are further divided into the MARSSIM–defined classes of 1, 2, or 3 on the basis of the potential for residual contamination and the BRAC radiological survey policy (U.S. Army 1998). Table 2-2 summarizes information about the areas affected by various NRC licenses.

2.2.1 Class 1 and Class 2 Areas

Areas were classified as Class 1 or 2 if historical information indicated that the commodity repair or maintenance activities conducted there compromised the nondispersible design of the commodities in accordance with the BRAC policy. Areas where tritium repair/maintenance occurred or where a past accidental release has not been remediated to present standards would also classified as Class 1 or Class 2 Areas. The previously surveyed and released 64 special weapons bunkers are the only known facilities where commodities containing tritium were stored and maintained. However, none of these is expected to contain residual tritium contamination.

In accordance with MARSSIM, areas were classified as Class 1 if potential radiological contamination (on the basis of site operating history) or known contamination (on the basis of previous radiological surveys) exists in excess of dose-based action levels. Building 612 is the only building or area classified as Class 1. The basis of this classification, however, relied on activities such as demilitarization of DU munitions that were permitted under SUC 1275, rather than activities that actually took place. As mentioned above, Building 612 has already undergone a survey for release. Survey data are currently being evaluated.

Areas were classified as Class 2 if the residual contamination was expected to be present, but not to exceed action levels at any location. The historical assessment resulted in classifying all of Buildings 5, 306, 2073, and S-2084 as Class 2 areas. This classification, however, is based solely on potential contamination for licensed activities. No confirmed contamination has been identified.

2.2.2 Class 3 Areas

Other indoor and outdoor areas where commodities were repaired, maintained, or stored were classified as Class 3 areas. Any areas where historical information indicated an accidental release had occurred but has already been remediated to present-day standards for unrestricted release were also classified as Class 3 areas. All of the storage bunkers initially have been classified as Class 3 areas. Storage bunkers were used only for storage of containerized DU ammunition, except for five bunkers, four of which were also used for previous special weapons storage, and one which was used for storage of rocket sights containing promethium-147. In addition to DU, the former bunkers will be surveyed for tritium and plutonium, and the latter for promethium-147, all as Class 3 areas. Warehouse 356 has also been classified as a Class 3 area, in this case for thorium associated with storage of Columbite and tantalum ore.

Table 2-2
Information Summary for Buildings under License SUC-1275 and Other NRC Licenses

Buildings/Structures	Radiological Status	Radionuclides of Concern	Area Classification for Final Status Survey	Type and Extent of Contamination	Other Licenses Affected	Operations Performed
Building 612	Building was surveyed in 1999. Walls, ceilings and floors were surveyed.	U-234, U-235, and U-238 (depleted uranium)	Class 1	Contamination, if present, is expected only on floor surfaces.	SUC-1380	Unpackage, inspect, and repackage DU ammunition
Building 5 Building 306 Building S-2084 Building 2073	During operations, periodic surveys were conducted and no elevated levels of radioactivity were ever detected. The last of the depleted ammunition was shipped off in September 1999.	U-234, U-235, and U-238 (depleted uranium)	Class 2	Contamination, if present, is expected only on floor surfaces	SUC-1380	Staging point to prepare DU ammunition for shipment
Storage Bunker A0701		Pm-147	Class 3	Contamination, if present, is expected only on floor surfaces	BML 12-00722-07 license managed by TACOM Rock Island	The license was for the possession of Pm-147 in the light anti-tank rocket system

Table 2-2 (Con't)

Buildings/Structures	Radiological Status	Radionuclides of Concern	Area Classification for Final Status Survey	Type and Extent of Contamination	Other Licenses Affected	Operations Performed
Of 11 pitchblende storage bunkers, E0801 and E-802 were under NRC license for subsequent DU storage	Were decontaminated and released for unrestricted use in 1985	Ra-226 (pitchblende ore) U-234, U-235, U-238	Class 3	Contamination, if present, is expected only on floor surfaces	SUC-1380	During the 1940s, the Depot stored barrels of pitchblende ore
Of 64 special weapons storage bunkers, A0201, A0316, A0317, and A0508 were under NRC license for later DU storage	Were surveyed in 1992 and 1993 and released for unrestricted use	Pu-239, U-234, U-235, U-238, and H-3	Class 3	Contamination, if present, is expected only on floor surfaces	SUC-1380	For special weapons storage
Ammunition Bunkers (see Table 2-1)	During operations, periodic surveys were conducted and elevated levels of radioactivity were never detected. The last of the depleted ammunition was shipped off in September 1999.	U-234, U-235, and U-238 (depleted uranium)	Class 3	Contamination, if present, is expected only on floor surfaces	SUC-1380	Storage of the packaged DU ammunition

Table 2-2 (Con't)

Buildings/Structures	Radiological Status	Radionuclides of Concern	Area Classification for Final Status Survey	Type and Extent of Contamination	Other Licenses Affected	Operations Performed
Warehouse 356	NRC released building for unrestricted use Amendment 16 to STC-133 on 12/22/94	Natural thorium	Class 3	Contamination, if present, is expected only on floor surfaces	STC-133 managed by Defense Logistic Agency	Warehouse was used to store Columbite and tantalum ore

3 IDENTIFICATION OF REMAINING DECONTAMINATION AND DECOMMISSIONING ACTIVITIES

On the basis of the historical site assessment and initial characterization information available, it is expected that no decontamination and decommissioning (D&D) would be required for the Seneca Army Depot Activity license termination. NRC concurred with the conclusion that a Decommissioning Plan is not required for this site in a July 26, 2000, letter to LTC Frank, Commanding Officer of the Depot (NRC 2000). If, during the final status survey, it is found that some areas are above the release criteria, a remediation plan would be developed, and those areas would be remediated.

4 REMEDIATION PLANS

At present, no D&D is thought to be required to meet NRC license termination criteria in Subpart E of 10 CFR 20 or unrestricted release criteria for any of the shared licenses listed in Section 1. Therefore, no remediation plan has been developed.

5 FINAL STATUS SURVEY PLAN

5.1 Introduction

The purpose of the Final Status Survey Plan is to describe the methods to be used in planning, designing, conducting, and evaluating final status surveys at SEDA. These surveys would serve to demonstrate that the dose from residual radioactivity is less than the maximum annual dose criterion for license termination for unrestricted use as specified in 10 CFR 20.1402. The Final Status Survey plan approach was developed following the Army radiological survey policy for BRAC sites (U.S. Army 1988) and MARSSIM (NRC 1997).

The Department of the Army radiological survey policy issued for BRAC sites where Army radioactive commodities have been present would be followed in the design and performance of surveys (U.S. Army 1998). According to that policy, commodity sites would typically proceed directly to closeout surveys (final status surveys under MARSSIM), consistent with a low likelihood of contamination. The overall process encompasses the following steps: (1) historical site assessment, (2) scoping surveys (if advantageous), (3) classification of areas, (4) formulation of survey plans with the host state and the U.S. Environmental Protection Agency (EPA), and (5) performance of closeout survey.

While several buildings remaining to be surveyed have been initially designated as Class 2 survey areas, meaning contamination is potentially present, the proposed surveys will be designed as final status surveys. Also, survey designs will incorporate some additional characterization sampling in selected locations to further confirm the absence of contamination. Sampling could include scans of air ducts and drains and the collection of material samples as deemed appropriate.

5.2 Scope

The Final Status Survey Plan would include the radiological assessment of all impacted structures and buildings and surrounding areas included under the NRC license. The purpose of the plan is to quantify the concentration of any residual radioactivity that may exist. Residual levels will be compared to dose-based concentration limits for all radionuclides of concern identified in the historical site assessment (Table 2-2) for soil and building surfaces. The unity rule will be followed in areas with more than one radionuclide of concern. These limits correspond to the maximum annual dose rate criterion for unrestricted release of licensed facilities as specified in 10 CFR 20.1402. The dose-based concentration limits are developed in Section 6 of this plan.

5.3 Summary of the Final Status Survey Process

The final status survey would provide data to demonstrate that all radiological parameters satisfy the established dose limits and conditions. The primary objectives of the final status survey are to (1) select or verify survey unit classification; (2) demonstrate that the potential dose from residual radioactivity is below the release criterion for each survey unit, and (3) demonstrate that the potential dose from small areas of elevated activity is below the release criterion for each survey unit. The final status survey process consists of four principal elements: (1) planning, (2) design, (3) implementation, and (4) assessment.

5.4 Survey Planning

Survey planning is performed to ensure that radiological surveys produce the data necessary to support release decisions. It involves historical site assessment and review of other pertinent characterization information to establish survey area classification and radionuclides of concern for each study area under the license. Concentration levels that correspond to the maximum annual dose criterion of 10 CFR 20.1402 are established by dose modeling for the type of contamination (surface or volume) found in the contaminated media (soil, building, or structures). The concentration criteria, referred as derived concentration guideline levels (DCGLs), allow for the practical implementation of the health-based dose limits.

For the purpose of performing radiological surveys, survey areas are divided into survey units, which are physical areas for which individual release decisions are made on the basis of survey measurements. A reference system is set up to document the location of survey measurements, whether taken in a biased manner, randomly, or over a grid. Reference areas are identified that are known to be free of contamination and that contain the types of materials existing in the survey units. Before surveying, radionuclide-specific DCGLs determined from dose modeling are converted to operational DCGLs, which are needed to interpret actual survey measurements. The survey measurements are conventionally made with survey instruments that measure gross radioactivity. The availability of the appropriate type and number of survey instruments with sufficient sensitivity to detect the operational DCGLs is then verified.

5.4.1 Classification of Survey Areas

Table 2-2 assigned initial classifications to all buildings and structures and surrounding areas on the basis of potential for residual contamination. These classifications represent the highest level of contamination known or expected to exist in the buildings based on historical information and surveys. The basis for the building classifications is given in Section 2.2. Table 5-1, below, presents the results of the latest round of surveys for the buildings of interest. The survey program has been an integral part of radiation safety portion of the NRC license. Regular surveys have been performed over the life of the license, giving further assurance of the uncontaminated condition of the facilities.

Table 5-1
Summary of Recent Building Surveys

Building No.	Date of Survey	Radio-nuclides of interest	Types of surveys performed	Instruments used	MDA (dpm/100 cm2)	Results
5		U-234, U-235, and U-238 (DU)	Dry swipe samples collected and analyzed at Redstone Arsenal, AL; walk-thru gamma survey	laboratory counters for swipes, Ludlum Model 3 pancake G-M for gamma rates	Alpha: 2 Beta: 6 Gamma: 109 Backgrd: 0.02 mR/hr	No results above background
306		U-234, U-235, and U-238 (DU)	As for Bld 5	As for Bld 5	As for Bld 5	No results above background
356		Th-232	As for Bld 5	As for Bld 5	As for Bld 5	No results above background
612	3/99 to 5/99	U-234, U-235, and U-238 (DU)	Over 2-m grid: Direct and swipes: alpha/beta/gamma Surface Scans alpha/beta/gamma 100 % scans	Hand-held and floor monitor gas-proportional counters, FIDLER low-energy gamma detector, laboratory counters for swipes	Swipes and gamma rate: as for Bld 5 Static direct: Alpha: 20/40 Beta: 1000/2000 Gamma: 16,000	No detects above action levels. (Data to be reviewed against revised action levels.)
2073		U-234, U-235, and U-238 (DU)	As for Bld 5	As for Bld 5	As for Bld 5	No results above background
S-2084		U-234, U-235, and U-238 (DU)	As for Bld 5	As for Bld 5	As for Bld 5	No results above background
Storage Bunkers		DU (all), Ra-226 (2 bunkers), H-3 and Pu-239 (4 bunkers)	As for Bld 5	As for Bld 5	As for Bld 5	No results above background

Within a survey area, one or more survey units may be defined that carry the same, or lower (numerically higher), contamination classification as the survey area. A survey unit is a physical area that has been subjected to a consistent set of contamination processes. It is the smallest area to which a release decision would apply. Survey units of the same classification within a survey area may vary substantially in size, but may be sampled with a similar number of measurements if they have similar contamination levels and variability and are subject to the same DCGL.

5.4.2 Survey Units

As described above, a survey unit is a physical area within a building or structure or land area of specified size and shape that would be considered as a unit during the final status survey process. Compliance criteria would be demonstrated for each survey unit. While individual rooms are considered in dose modeling to calculate DCGL values for buildings, survey units used to establish compliance with DCGLs may encompass more than a single room, as long as the total area of the survey unit does not exceed the following guidelines suggested in MARSSIM:

Class 1 Structures:	up to 100 m^2	Class 1 Land Areas:	up to 2,000 m^2
Class 2 Structures:	100 to 1,000 m^2	Class 2 Land Areas:	2,000 to 10,000 m^2
Class 3 Structures:	no limit	Class 3 Land Areas:	no limit

Floor plans showing survey area classifications within the buildings are given in figures 5-1 through 5-7. Table 5-2 presents the number and sizes of survey units proposed within the survey areas. For Class 2 areas within buildings, each room or distinct area within the Class 2 area is designated a separate survey unit. Class 3 areas may comprise a single or several survey units. A total of 21 Class 2 survey units are proposed for the four buildings that have Class 2 areas, and a total of 7 Class 3 survey units are proposed for the three main buildings that have Class 3 areas. The 121 storage bunkers will each be surveyed as a single Class 3 survey unit. The proposed survey unit sizes fall well within the guidelines. Note that Building 612 surveys have already been performed (walls, ceilings, and floors) with some survey units exceeding Class 1 size guidelines. If, upon review, residual contamination levels are found to be well below action levels, the few such survey units may be found to be of acceptable size to support release decisions. As noted in Table 2-2, contamination in all buildings, if present, is expected to exist only on floor surfaces. Walls and ceilings will not be sampled with direct measurements at specific locations, but will be scanned and sampled as determined by judgement.

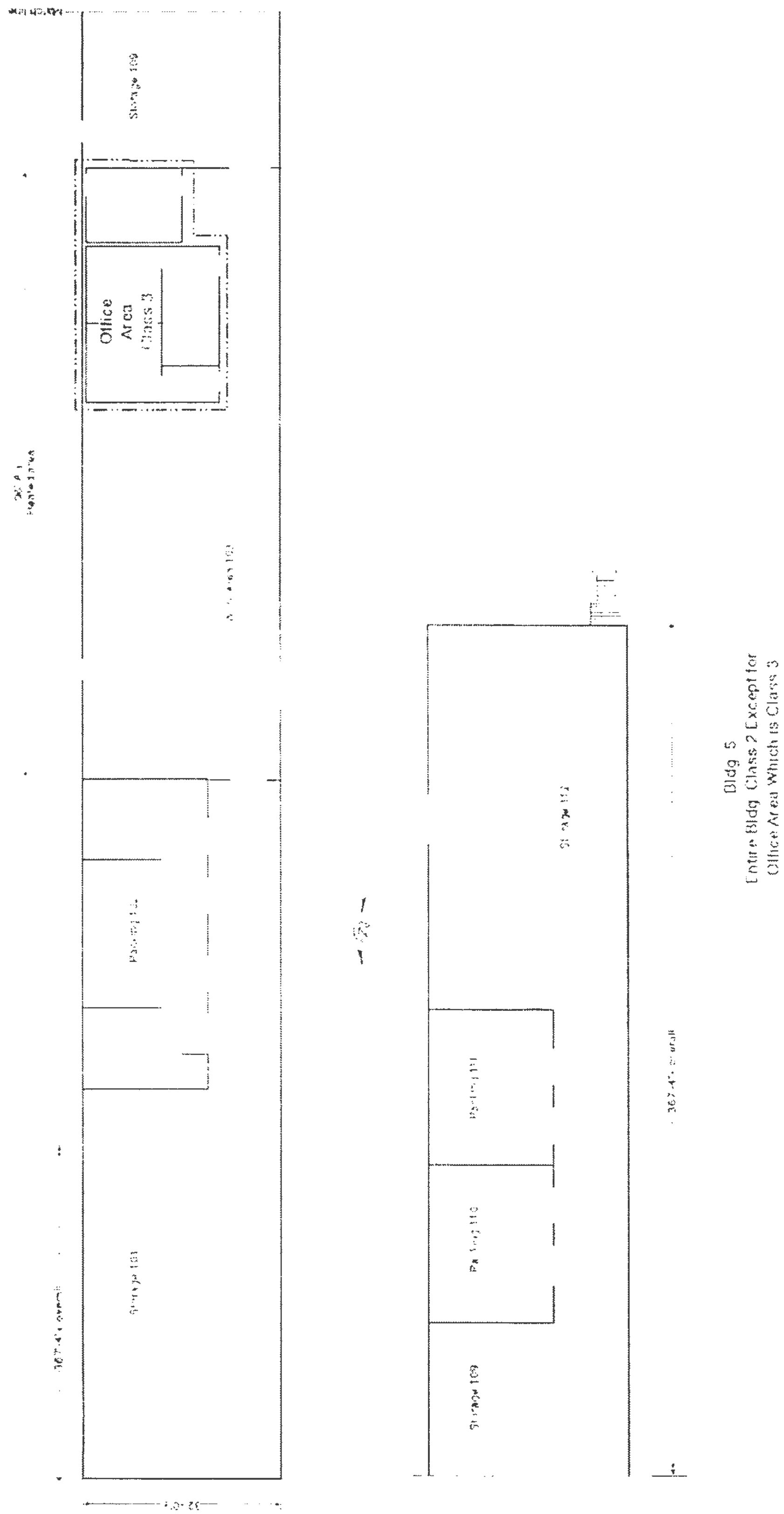


FIGURE 5-1 Building 5 Survey Areas

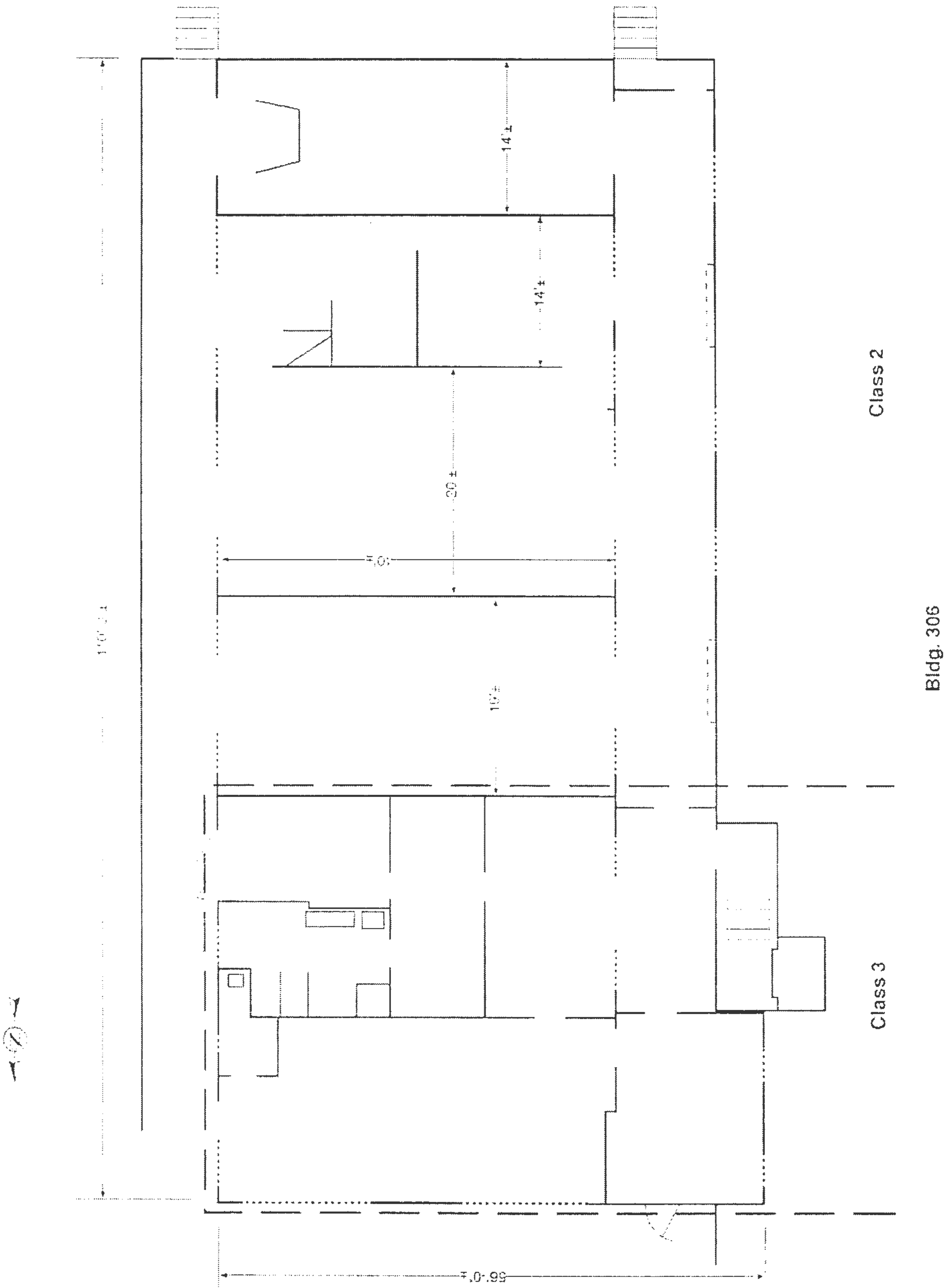


FIGURE 5-2 Building 306 Survey Areas

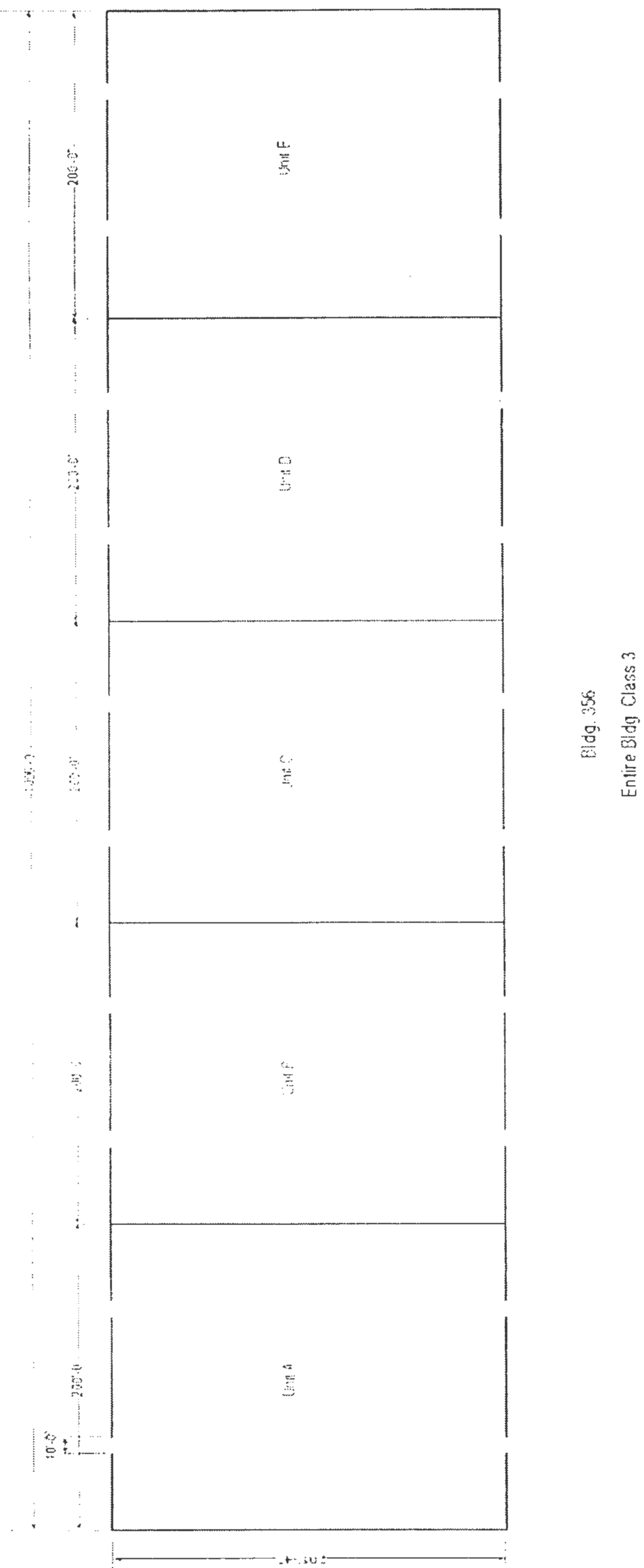


FIGURE 5-3 Building 356 Survey Areas

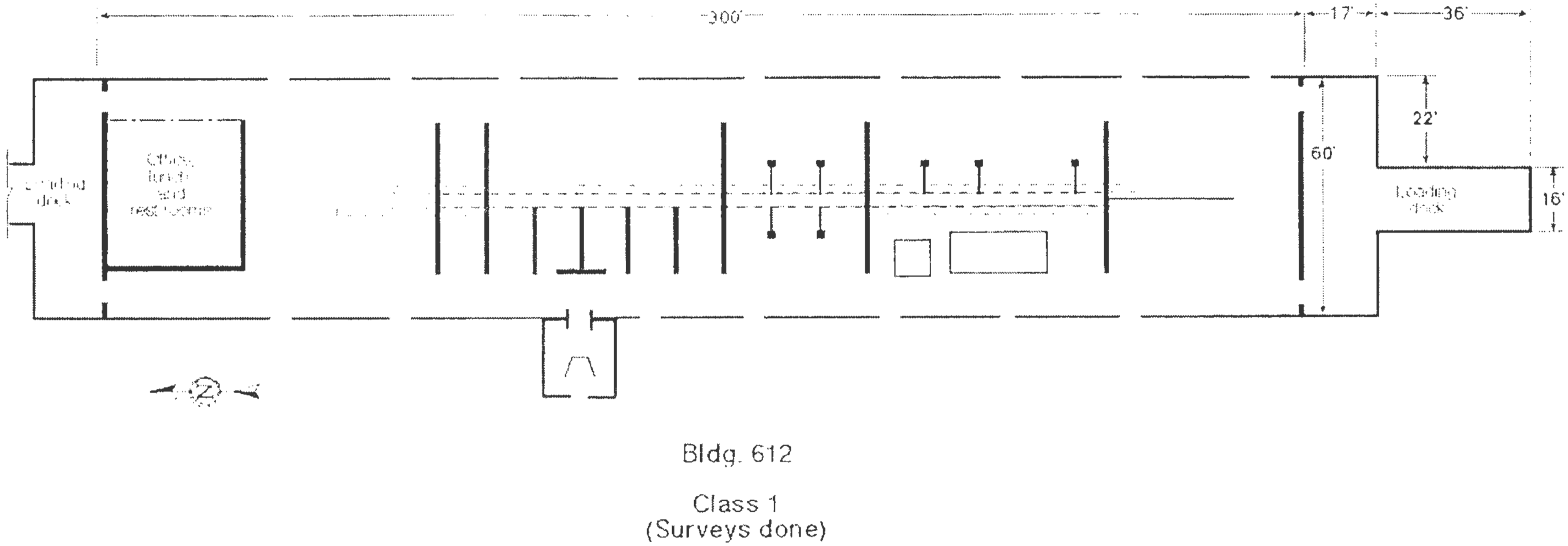


FIGURE 5-4 Floor Plan of Building 612 (surveys previously performed in 28 Class 1 survey units)

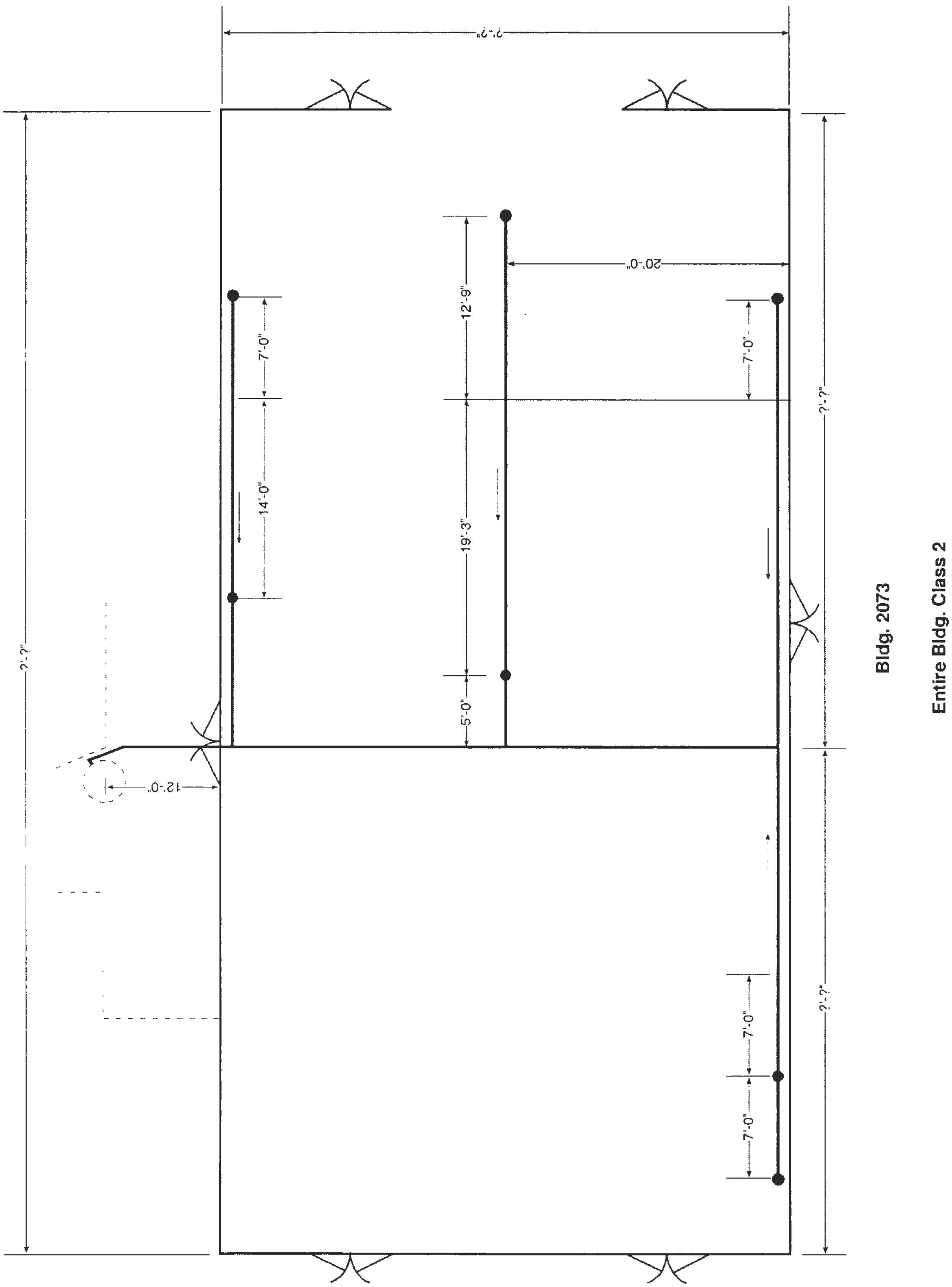
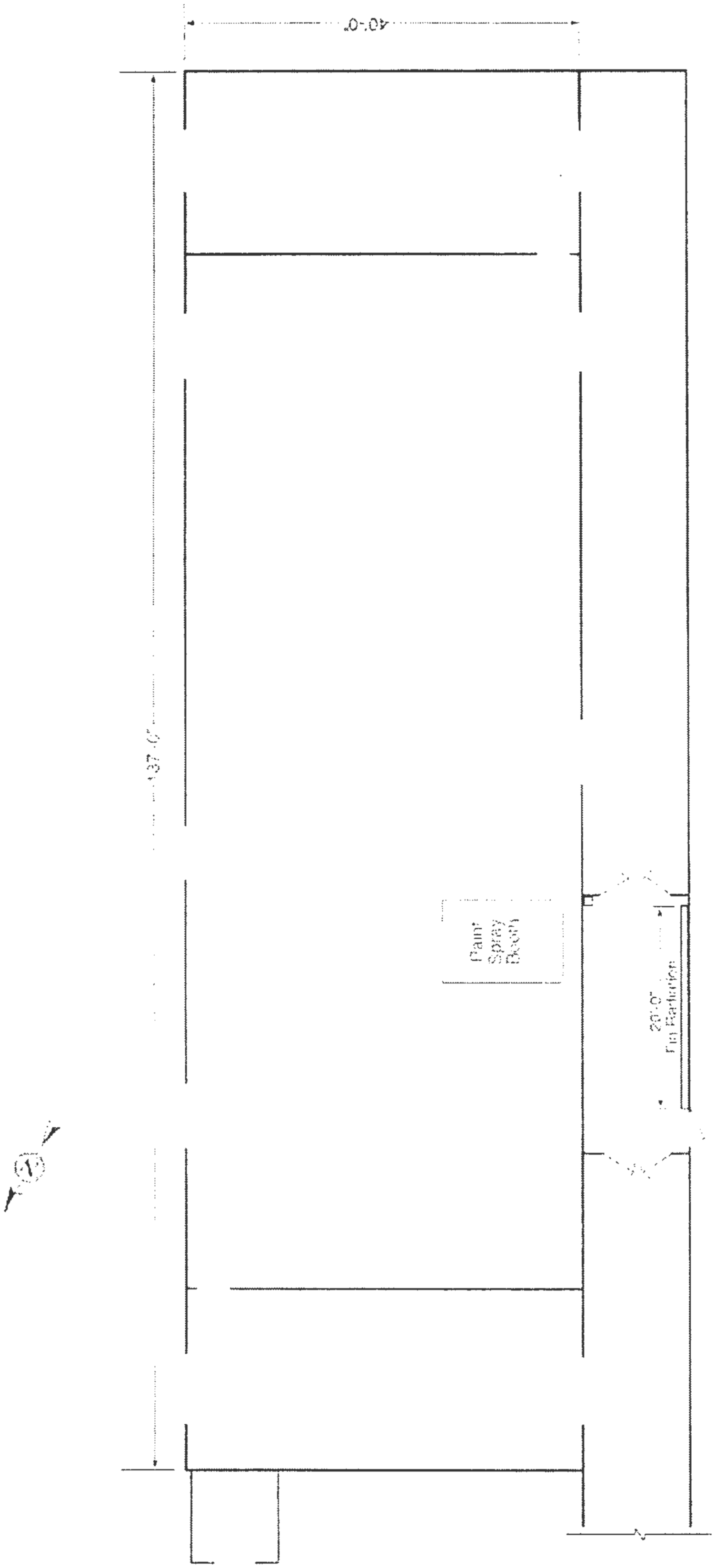


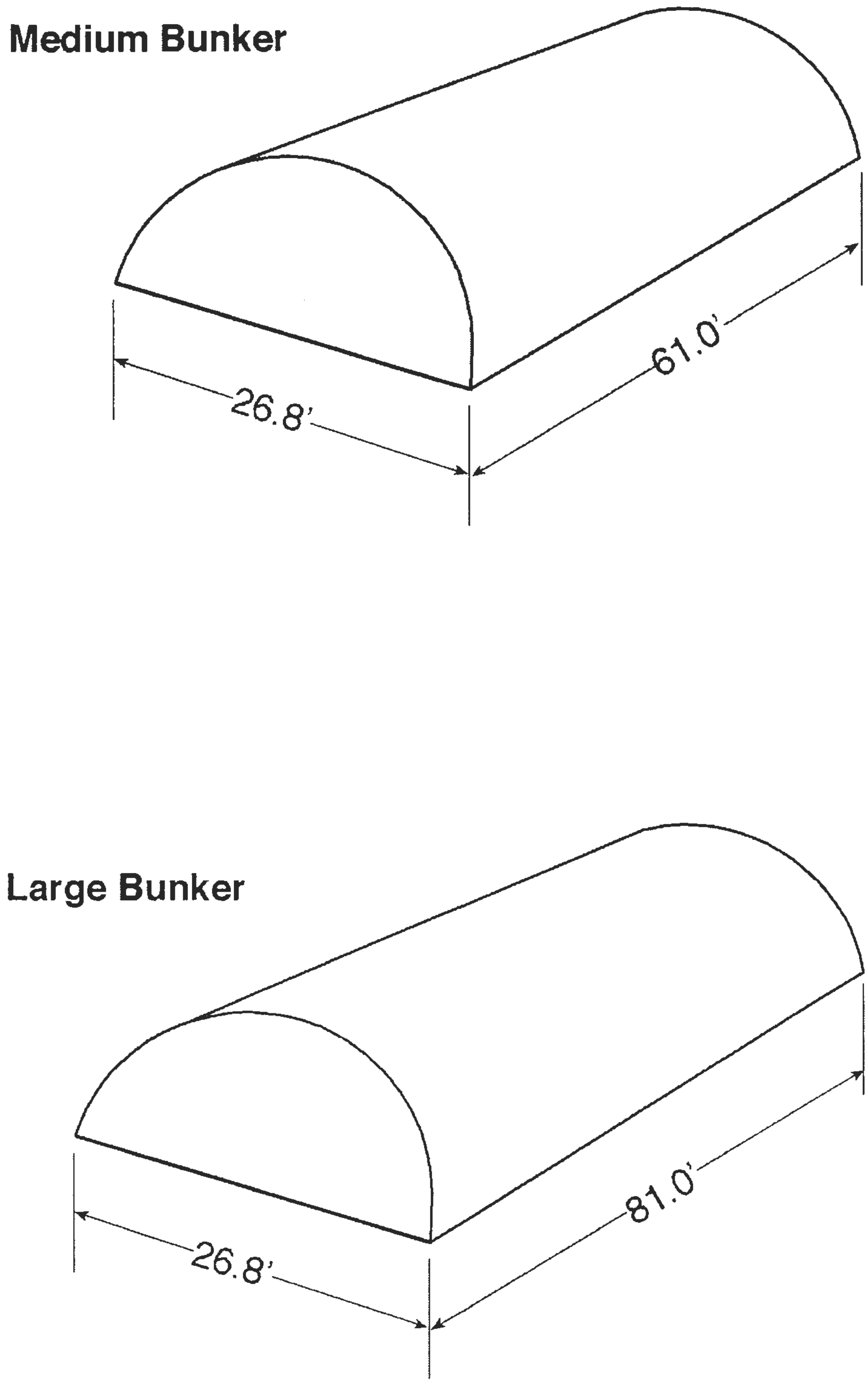
FIGURE 5-5 Survey Areas for Building 2073



Bldg. 2084

Entire Bldg. Class 2

FIGURE 5-6 Survey Areas for Building S-2084



Class 3

FIGURE 5-7 Survey Areas for Storage Bunkers

Table 5-2
Summary of Building Survey Units

Building No.	Total floor area (m^2)	No. Survey Units/Size (m^2)		
		Class 1	Class 2	Class 3
5	1092	0	7 (1000 total)	1 (92)
306	536	0	7 (312 total)	1 (224)
356	18,600	0	0	5 (3720 ea.)
612	1,730	28 (3-250, completed)	0	0
2073	280	0	3 (280 total)	0
S-2084	510	0	4 (510 total)	0
Storage Bunkers (121 total)	150 (20-m length) 200 (25-m length)	0	0	93 (150 ea.) 28 (200 ea.)

5.4.3 Reference Coordinate Systems

Each survey unit would have a benchmark defined that would serve as an origin for documenting survey results. For buildings, a grid numbering system will be used for buildings that starts, for example, in the northeast corner and is numbered consecutively beginning with an "F" for floors, "W" for walls, "C" for ceilings, and "H" for other horizontal surfaces. The location of judgment samples in buildings will be documented in terms of linear horizontal and vertical distances from a designated corner and will be recorded on a drawing of the area. Samples taken from the grounds outside of buildings will be recorded with a standard geographic reference system with respect to a local geographical marker.

5.4.4 Reference Areas

To represent background radiological conditions at the site (structures and buildings, land areas) and to provide reference areas for conducting statistical comparisons of study areas, measurements will be made in one or more reference areas that have not been affected by site operations. Measurements have previously been made to establish background levels for gross activity in various materials in two different buildings, C0912 and 722. Table 5-3 provides the results of measurements for different survey instruments in C0912, a storage bunker that was not used for any radiological storage (U.S. Army 2001). Bunker C0912 will continue to serve as a control for future surveys of storage bunkers. It will be surveyed again as part of the current license termination effort.

Table 5-3
Survey Results for Different Survey Instruments Used in Building CO912

Instrument	Floor or Wall (Bunker C0912)	Background Range (counts per minute, cpm)
Gas Proportional – Floor Monitor (probe area = 425 cm^2)	Floor- Alpha Floor –Beta Floor – Alpha + Beta (scanning)	3-8 650-757 400-800
Gas Proportional – Hand-Held (probe area = 100 cm^2)	Wall – Alpha Wall- Beta Wall – Alpha + Beta (scanning) Floor – Alpha + Beta (scanning)	0-5 (0 for smears) 121-166 (0 for smears) 60-200 60-200
Phoswich (plastic scintillator, probe area = 86 cm^2)	Floor – Alpha Floor – Beta Wall – Alpha Wall – Beta Floor – Alpha + Beta (scanning) Wall - Alpha + Beta (scanning)	0-3 270-326 0-6 216-411 200-400 200-460
FIDLER (sodium iodide crystal, probe area = 126 cm^2)	Floor – Gamma (direct) Wall – Gamma (direct) Floor – Gamma (scanning) Wall – Gamma (scanning)	7,849-8,219 7,583-8,136 6,000-12,000 5,800-10,500

Building 722 surveys were performed with the same or similar devices on a variety of surfaces, materials, and equipment items. Gross activity levels covered a range similar to that in C0912. Building 722 is no longer available as a reference area for buildings other than storage bunkers. Building 123 is a suitable reference building and is proposed to serve that purpose for buildings other than storage bunkers. In addition, an area of soil that has not been impacted will be surveyed to establish background levels for field sodium iodide (NaI) detectors.

5.4.5 Selection of DCGLs

Two types of DCGLs are used for comparison of survey data. When computed for the average residual radioactivity in a survey unit, the derived guideline level is called a $DCGL_W$. A second guideline is derived for application to smaller areas, typically within a Class 1 survey unit. It is called the $DCGL_{EMC}$, where EMC stands for elevated measurement comparison. Both guidelines derive from the same dose, with the $DCGL_{EMC}$ corresponding to somewhat higher concentration levels in small areas that are computed using area factors. Used together for comparison to survey measurements, the two DCGL values ensure that an individual would not receive a dose in excess of the established criterion for unrestricted use.

Section 6 describes the modeling performed to develop the radionuclide-specific DCGLs for soil and building surfaces. These values will be used to establish operational DCGLs for survey units where measurements will be made that are not radionuclide-specific. They would also be used in the case when surrogate radionuclides were used. The operational DCGLs will be established for each survey unit on the basis of a representative radionuclide mix. For alpha or beta surface activity measurements, field measurements will consist of gross activity assessment. In these cases, gross activity DCGLs would be established on the basis of a representative radionuclide mix. The surrogate DCGLs, if needed, would be computed from the activity ratio between a difficult-to-detect radionuclide and the easy-to-detect radionuclide. The activity ratio would be established from characterization data. To establish $DCGL_{EMCs}$, area factors would be calculated.

In areas where there is more than one radionuclide of concern, the unity rule would be followed. That is, the sum of the ratios of the residual concentration of each radionuclide to its respective DCGL would not exceed unity. For the current plan, DU is the only contaminant of concern for the vast majority of areas. DU consists of U-238, U-235, and U-234, and their associated progeny. To simplify the release criteria, the isotopic composition of DU will be factored into a single operational DCGL value that can be implemented in a single gross alpha activity measurement. The combined DCGL will account for all the radioactive isotopes in the standard composition of DU stored at the Depot.

5.5 Final Status Survey Design Elements

After the $DCGL_W$ is established, a survey design will be developed that will select the appropriate survey instruments and techniques to provide adequate coverage of survey units though a combination of scans, fixed measurements, smears, and material sampling. This survey design process will ensure that data of sufficient quantity and quality are obtained to make decisions as to whether survey units meet the release criterion. Components of this process are as follows:

- Scanning measurements will be used to locate areas of elevated radioactivity, which may be evaluated in terms of the $DCGL_{EMC}$. Scanning measurements are made by moving a detector over an area at a uniform rate and distance from the surface. Measurements of gross alpha, beta and/or gamma activity will be made as determined by the nature of the radioactivity of the radionuclides of concern in a survey unit.

- Direct measurements of gross radioactivity will be taken at the centers of a systematic grid laid over survey units. A direct measurement is made by holding a detector at a fixed location over a surface for a specific counting duration. These measurements will be averaged over a survey unit for statistical comparison to the $DCGL_W$ using the Wilcoxon Rank Sum test. Grids will be laid out with a randomly determined starting point so measurements at the grid centers can be considered unbiased for statistical comparisons.

- Smear samples will be taken in survey units at the same locations as direct measurements. Where tritium is a contaminant of concern, wet smears will be taken. Results will be used for diagnostic purposes.

- Air duct and drain surveys may be performed in Class 2 buildings. Survey instruments, such as a "peanut" NaI detector, may be inserted into ducts or drains by using a rod or similar device to reach the accessible reaches of these conduits for characterization purposes. Smears or material samples may also be taken at the entry points of air ducts and drains.

- In situ measurements of gross gamma activity in soil will be taken at selected locations to detect the presence of any activity that may have been carried outside (e.g., by foot traffic or floor sweeping). Soil samples may be taken at locations of elevated activity. Measurements will be compared to soil DCGLs (Section 6.3).

5.5.1 Selecting the Number of Fixed Measurements and Locations

Fixed measurement surveys will be designed to meet the data quality objectives (DQOs) of the survey program. DQOs define the types, number, and locations of measurements needed to support a decision within prescribed limits of error, in this case, decisions regarding meeting release criteria. DQOs further indicate which survey instruments are appropriate for performing the surveys. Procedures for designing fixed and scanning measurement surveys and selecting instruments to meet program DQOs are given in MARSSIM. The BRAC radiological survey policy applies the principles in MARSSIM to BRAC commodity storage and repair sites in the specification of semi-standard survey designs.

5.5.1.1 Class 1 and 2 Survey Units

In accordance with MARSSIM and the BRAC radiological survey policy, Class 1 and 2 survey units will be surveyed with a combination of scanning measurements, direct measurements, and smear samples of removable activity. Material samples may also be taken from drains and air vents.

Scans will be performed over all or portions of Class 1 and Class 2 survey units:

- Class 1 surface areas receive a 100% scan of all surfaces

- Class 2 survey units receive scans of between 10 and 100% of floor and lower wall sections and between 10 and 50% of upper walls and ceilings. The specific areas to be scanned in Class 2 survey units will be determined by judgment on the basis of process knowledge and the potential for radiological contamination. Scans may also be performed inside drains and air ducts. Also, any fixtures or furniture that will be transferred along with the building will be scanned before release.

Direct measurements of radioactivity will be made on a systematic grid laid over a survey unit:

- For Class 2 areas, the number of direct measurements to be taken within a survey unit have been determined according to the methods and equations given in MARSSIM (Section 5.5.2). For contaminants present in background, such as uranium isotopes, or when gross activity measurements are made, as in the current case, data from direct measurements are evaluated in terms of the $DCGL_W$ by using the Wilcoxon Rank Sum test. The number of samples required to perform this statistical test depends on several factors, including predetermined acceptable rates of decision errors, the width of the "gray region" on a decision plot (MARSSIM, Section 5.5.2.2), and the variability of residual contaminant levels. Specific values of acceptable decision error rates, estimates of the standard deviation, and the resultant number of samples for the currently proposed surveys are provided in Table 5-4. While only 6 or 7 samples are required in survey units because of generally large relative shifts, a standard number of **10 samples per survey unit** is proposed for all Class 2 survey units to ensure a sufficient number of samples.

- Class 1 areas would be subject to an additional effort to detect areas of elevated contamination in excess of the $DCGL_{EMC}$. Because the $DCGL_{EMC}$ corresponds to the same dose as the widearea $DCGL_W$, but for a small area, it has a corresponding higher value. The actual value of the $DCGL_{EMC}$ is a function of the potential size of such elevated areas. The maximum size of an elevated area that would not be detected by direct grid measurements is roughly of the size of a grid cell. Therefore, grid size may have to be reduced and direct measurement numbers increased, to limit the size of elevated areas using Area Factors as described in MARSSIM (Section 5.5.2.4).

The currently proposed surveys include only areas initially classified as Class 2 or Class 3 areas. If any contamination exceeding $DCGL_w$'s were to be found in the scanning measurements of the Class 2 areas, these areas would be reclassified as Class 1 (see Section 5.5.3). As this possibility is considered remote, grid sizes and sample numbers will be determined without regard to the need to meet criteria for elevated areas. Should an area be reclassified as Class 1, however, grid sizes for direct measurements will be recalculated, taking into account the need to implement the $DCGL_{EMC}$ for elevated areas. As indicated above, all non-bunker buildings, except Warehouse 356 and Building 612, and grounds will initially contain at least one Class 2 area. Warehouse 356 is designated a Class 3 area, while Building 612 has already been surveyed in its entirety as Class 1.

Table 5-4
Minimum Number of Direct Measurements to be taken in Class 2 Survey Units

Bldg. No.	Limiting[1] radio-nuclide	Operational[2] $DCGL_w$ (dpm/100 cm^2)	LBGR[3] (dpm/100 cm^2)	CV[4]	Relative[5] Shift	α[6]	β[7]	N/2 for[8] WRS test
5 306 612 2073 S-2084 Storage Bunkers	U-235	5690	500 (alpha)	0.3	35	0.05	0.10	6
356	Th232+ Ra-228+ Th-228	340	200 (alpha)	0.3	2.3	0.05	0.10	7
A0201 A0316 A0317 A0508	Pu-239 H-3	2020 3.58E+09	200 (alpha) 3xE+05 (beta)	0.3 0.3	30 3.9E+4	0.05 0.05	0.10 0.10	6 6
A0701	Pm-147	3.47E+07	3E+04 (beta)	0.3	3850	0.05	0.10	6

[1]The limiting radionuclide of potential concern in a given building has the lowest DCGLw as given in Table 6-8 for any radionuclide for any room size.

[2]The operational DCGLw is associated with the limiting nuclide. It is the lowest value for any room size and allows conservative implementation of dose limits using gross activity field measurements.

[3]The lower bound of the gray region (LBGR) is the highest residual contamination level for which specified decision error rates are applicable. That is, it is the highest residual level that can be shown to be below action levels based on sample data, given expected sampling and analysis error. The selected LBGR affects the number of samples, N, needed to perform the WRS test. The value of 500 dpm/100 cm^2 for U-235 (DU) is an order of magnitude below the DCGL yet far above expected residual levels. The value of 200 dpm/100 cm2 selected for other alpha emitters, including DU, Pu-239, and natural thorium, is an order of magnitude above the MDA of the floor monitor, about 20 dpm/100cm2, yet well below DCGLs. Actual residuals are expected to be close to background (1-2 cpm/100 cm2). The value of 3E+05 dpm/100 cm2 for H-3 is one-half of ANSI N13.12 (1999), the surface standard for clearance. The value 3E+04 dpm/100 cm2 for Pm-147 is an order of magnitude above the MDA for beta for the floor monitor, roughly 3000 dpm/100 cm2, and far below the DCGL.

[4]The coefficient of variation, CV, is the estimated relative standard deviation of measurements of residuals. It is set at 0.3 per MARSSIM, Section 5.5.2.1, in the absence of preliminary data.

[5]The relative shift is defined as (DCGLw – LBGR)/σ, where σ is the estimated standard deviation of the survey unit, in this case, CV x LBGR.

[6]α is the specified acceptable level of Type I (false positive) decision errors, when the null hypothesis is that the survey unit exceeds the cleanup standard.

[7]β is the specified acceptable level of Type II (false negative) decision errors.

[8]N/2 is the number of samples required in survey units and background units to perform the WRS test given the specified relative shift and decision error limits. N is calculated as follows:

$$N = (Z_{1-\alpha}+Z_{1-\beta})^2 \ / \ 3(P_r-0.5)^2$$

Where:

$Z_{1-\alpha}$ and $Z_{1-\beta}$ are values from the standard normal distribution, and

P_r is the probability that a random measurement from the survey unit exceeds a random measurement from the background reference area by less than the $DCGL_W$ when the survey unit median is equal to the LBGR above background.

5.5.1.2 Class 3 Survey Units

By definition, MARSSIM Class 3 survey units are not expected to contain any areas of contamination. They will not, therefore, be subjected to wide-area scanning. Rather, a judgment approach will be used to select areas that would most likely be contaminated if any contamination were present. Areas will be selected on the basis of process knowledge and pathway analysis to select locations that, if free of contamination, would indicate that the survey unit as a whole was also clean.

In accordance with the BRAC radiological survey policy, Class 3 areas will undergo random sampling to verify that release criteria are met. Random sample locations are determined from a random number table or generator; they are not laid out over a grid. Following the BRAC policy, and consistent with MARSSIM, 30 random samples will be collected over an indoor area of up to 1,500 m^2. All of the approximately 120 storage bunkers and surrounding grounds under the license will be surveyed as Class 3 areas.

5.5.2 Judgmental Assessment

As discussed above, radiological surveys will be conducted in a judgmental manner to various extents in Class 2 and Class 3 areas as process knowledge and history would indicate. The purpose of such surveys is to confirm the absence of contamination in locations where it most likely would exist. Locations would be selected from a conceptual model of what processes took place within the facilities and how and where contamination might have migrated or collected. Surveys will typically be performed with scanning measurements. However, if areas of interest are small, such as at a drain opening, direct measurements may also be taken to improve detection limits.

5.5.3 Data Investigations

A review of survey data will be performed as they are collected to support two main objectives — to ensure that measurement devices are working within their expected normal ranges, and to support accurate classification of survey areas, which supports the design of final status surveys. Such data reviews would help assure the effectiveness of the final surveys. Accurate initial classification of areas would prevent under or over surveying of those areas.

The criteria selected for use in data investigations will depend on survey unit classification. In the current program, all survey units will be initially classified as either Class 2 or Class 3. In Class 2 survey units, no measurements are expected to exceed $DCGL_w$'s. Therefore, any direct or scan measurement approaching or exceeding $DCGL_w$'s will be investigated. In Class 3 areas, any direct measurement or scan above background would be investigated, as these areas are assumed to be uncontaminated.

Data investigations would address concerns of the existence of isolated areas of elevated radioactivity that are not addressed in the design of Class 2 or Class 3 surveys. They will involve first confirming the elevated measurement with a second measurement. If the elevated reading is confirmed, the area around the measurement point would be investigated to define the extent of contamination. Possible sources of the contamination would be postulated, and the conceptual model would be modified to suggest other locations of similar concern. Pending the results of these efforts, an area may be reclassified to a more restrictive classification. Such reclassification may require resurvey of the study areas under an appropriate survey design. This procedure may be conducted without NRC approval. Conversely, any reclassifications to less restrictive classifications would require preapproval by NRC.

5.6 Survey Implementation and Data Collection

Survey implementation is the process of carrying out the survey plan for a given survey unit. This consists of making scan measurements and fixed measurements, and collecting and analyzing samples. Scan measurements will always be made, while fixed measurements and sampling may not be necessary.

5.6.1 Survey Methods

Surveys will employ a combination of judgmental and statistical measurements, using scanning, direct, and material sampling, to implement dose-based release criteria. The degree and proportion that each of these types of measurements will be used will depend on area classifications. Measurement devices will be employed that are appropriate in terms of the types of radiation expected and sensitivity required for the various types of measurements being made. The devices will be calibrated to NIST-traceable standards in accordance with the NRC licenses.

5.6.2 Survey Instrumentation

5.6.2.1 Scanning Surveys

Instruments selected for scanning surveys will be of a type that responds to the principal types of radiation, alpha, beta, or gamma that are emitted from radionuclides of concern. As DU is the contaminant of concern in the vast majority of areas covered by this plan and because the primary emissions of its constituents are alpha particles, gross alpha detectors will be the primary instruments used in these surveys. In a few locations, where tritium or promethium-147, which are beta emitters, will be of interest, instruments that detect gross beta will be used. Tritium and other low-energy emitters will be analyzed primarily on smear samples using laboratory liquid scintillation counting (LSC). Gamma detection instruments, such as NaI devices, will be used to a limited extent in buildings, primarily for characterization of uranium isotopes or decay products in selected locations or in locations that are difficult to access with alpha probes. Gamma detectors, however, would play a primary role in any outdoor scanning surveys.

The devices listed in Table 5-5 have been used effectively in the past at the Depot for both scanning and direct measurements (U.S. Army 2000, 2001). The same or similar instruments will be used in the current surveys. The minimum detectable activities (MDAs) listed in Table 5-5 were determined (U.S. Army 2000) using MARSSIM equations 6-8, 6-9, and 6-10 combined as follows:

$$MDA_{scan} = \frac{60/_i * 1.38\sqrt{B_R * t}}{\sqrt{p} E_d E_s \frac{A}{100cm^2}}$$

MDA_{scan}	=	Minimum detectable scanning activity in dpm per 100 cm^2
B_R	=	Background rate in cpm
P	=	Surveyor efficiency (0.5, MARSSIM)
i	=	Observation time interval in seconds
t	=	Scan observation interval in minutes (0.03 mins, MARSSIM)
E_s	=	Surface efficiency in counts per disintegration (0.5. MARSSIM)
E_d	=	Detector efficiency in counts per disintegration
A	=	Active probe area in cm^2

The value for the observational time interval (i), the time a given point is under the probe during scanning is assumed to be 2 seconds (0.03 minutes) per MARSSIM guidance. The factor 1.38 in the numerator of the above equation is taken from MARSSIM table 6.5 and corresponds to a 95% rate of true detects and a 60% rate of false positives. Such error rates are compatible with the objective of first-time screening of areas where one wants to err on the side of detection.

5.6.2.2 Direct Measurements

Direct radioactivity measurements will primarily be made with the same devices used for scanning (Table 5-5). When the same device is used for both scanning and direct measurements, such measurements may be carried out concurrently in an area to optimize field efforts. A standard counting time of, for example, 1-minute will be used for direct measurements. MDAs should be no higher than 10-50% of DCGLs to assure detection of concentrations of interest. MDAs listed in Table 5-5 were calculated from MARSSIM equation 6-7 as follows:

$$MDA = \frac{3 + 4.65\sqrt{B}}{E * \frac{A}{100}}$$

where

MDA = Minimum detectable concentration

B = Background counts in cpm

E = Detector efficiency in counts per disintegration

A = Active probe area in cm^2

From the discussion in Section 6.7.1 of MARSSIM, the constants in the numerator of the above equation, 3 and 4.65, correspond to false positive and false negative rates for detection of 5%.

Smear samples will be screened in the field for gross alpha and gross beta activity with a hand-held gas proportional detector. Smears and/or material samples may also be sent for laboratory analysis of specific radionuclides. The analyses would be performed to confirm the radiological composition of the contamination underlying elevated gross activity measurements. Laboratory methods would employ conventional spectrometric and counting methods that meet the survey program measurement objectives.

For the interpretation of gross activity readings in the field, flag values will be computed in terms of the instrument count rate (cpm) that is equivalent to the operational DCGL for a given radionuclide mix in dpm/100 cm^2 plus background (Bkg) count rate (cpm) as follows:

$$\text{Flag cpm} = \text{Bkg cpm} + A \times E \times \text{DCGL}/100\ cm^2$$

where

A = detector probe size (cm^2),

E = detector efficiency (unitless), and

DCGL = the operational DCGL (pCi/g or dpm/100 cm^2).

Table 5-5
Instruments Used in Previous Seneca Depot Activity Surveys[a]

Instrument[b]	Model	Serial No.	Probe Area (cm^2)	Rad Type	Source	Eff	Bkg (cpm)	Scan MDA dpm/100 cm^2)	Static MDA (dpm/100 cm^2)
Floor monitor	Ludlum 2360	138256	425	Alpha	Th-230	0.12	2	60	20
Floor monitor	Ludlum 2360	138256	425	Beta	Tc-99	0.22	800	610	140
Floor monitor	Ludlum 2360	138262	425	Alpha	Th-230	0.09	1	50	20
Floor monitor	Ludlum 2360	138262	425	Beta	Tc-99	0.20	440	500	120
Hand-held	Ludlum 2360	138238	100	Alpha	Th-230	0.18	1	110	40
Hand-held	Ludlum 2360	138238	100	Beta	Tc-99	0.20	73	870	280
Hand-held	Ludlum 2360	138254	100	Alpha	Th-230	0.20	1	100	40
Hand-held	Ludlum 2360	138254	100	Beta	Tc-99	0.21	81	870	210
FIDLER[c]	Bicron Analyst	A959P	126	Gamma	Am-241	0.02	6500	65,000	15,000

[a] Notation:
cm^2 = square centimeters
Eff = detector efficiency (ratio of detector counts per minute to source disintegrations per minute at a fixed geometry)
Bkg = background
cpm = counts per minute
MDA = minimum detectable activity (dpm/100cm^2 of area scanned)
dpm = disintegration per minute

[b] Floor monitor and hand-held devices are gas proportional counters: the FIDLER is a sodium iodide (NaI) detector. Laboratory LSC will be used to analyze low-energy beta emitters, including H-3 on smears.

[c] The apparent low efficiency of the FIDLER will be checked for future surveys.

5.6.3 Survey Considerations

5.6.3.1 Scanning Thresholds and Locations and ALARA

Some guidelines are necessary for the conduct and interpretation of scanning measurements in Class 2 and Class 3 areas. The MDAs of the scanning instruments used may be above the $DCGL_W$ release criteria, particularly in outdoor areas. Also, in Class 2 and Class 3 areas, $DCGL_{EMC}$ criteria for elevated areas are not employed, because the probability of the presence of such areas is considered remote. In such cases, the principle of "best reasonable effort" will be used to achieve practical scanning detection thresholds used in systematic or judgmental scanning surveys.

Detecting DU on building surfaces at $DCGL_W$ release criteria (Section 6) with conventional gas proportional counters does not appear to be a problem, considering established MDAs. Detection limits may be more of an issue for scanning measurements made in land areas with NaI detectors, such as the FIDLER. However, it is expected that direct readings with such devices should be able to detect, for example, uranium-238 at the soil DCGL of 103 pCi/g (MARSSIM, Appendix H, and Section 6.3 of this report). In judgmental surveys using NaI detectors, in order to improve detection limits, scanning speed may be reduced or direct measurements made in locations deemed most likely, on the basis of conceptual models, to be contaminated. This approach would be considered as achieving the goal of detecting contamination "as low as reasonably achievable" or ALARA.

Along these lines, the strategy for selecting locations for 10 to 100% scanning in Class 2 areas will be based on a conceptual model of contaminant distribution, focusing on areas most likely to be contaminated. If no other basis for determining scanning locations exists, at least 10% of areas would be scanned along systematic transects of survey units, or with randomly selected grid cells. In either Class 2 or Class 3 areas, any survey reading above background levels will be investigated further by appropriate means.

5.6.3.2 Surveying Land Areas

The grounds around the major buildings and areas outside the entranceways to the storage bunkers will be included in investigations. Land areas will initially be investigated by taking in situ gamma measurements in selected locations. If any indication of contamination is found, survey units will be defined. Such soil survey units might encompass two or more adjacent buildings. Radionuclides of concern for land areas would be the same as for the associated building or buildings. Survey instruments for land areas, however, will differ from those used inside buildings. Outdoor surveys will rely primarily on gamma detection of radionuclides of concern or associated decay products. Both scanning and direct measurements may be made with a FIDLER or other gamma detector, such as a 2X2 NaI crystal.

5.7 Survey Data Assessment

The survey data assessment process includes data verification and validation, review of survey design basis, and data analysis. For a given survey unit, the survey data are evaluated to determine if the residual radioactivity in the survey unit meets the applicable release criterion and if any areas of elevated activity exist. MARSSIM specifies two non-parametric statistical tests (Sign test and Wilcoxon Rank Sum test) to be applied to final status survey data to evaluate whether a set of measurement results demonstrates compliance with the release criterion for a given survey unit. The Sign test is applied if data are radionuclide specific and the radionuclide of interest is not present in the background. The Wilcoxon Rank Sum test is applied if the radionuclide does appear in the background or if gross activity measurements are considered.

5.8 Final Status Survey Reports

The documentation describing the final status survey for a given survey unit would be prepared and made available to NRC. The survey report would be a stand-alone report and would include the following:

- A physical description of the survey area that encompasses the survey units (the survey areas and survey units may be same);
- The characterization data associated with the survey area;
- The classification history of the survey unit;
- The remediation activities (if any) performed in the survey unit;
- A discussion of the survey design;
- Tabular and graphical depiction of survey results;
- Discussion of data assessment, including graphical depictions; and
- Conclusions that survey units meet all applicable criteria.

5.9 Quality Assurance and Quality Control Measures

Quality assurance and control measures (QA/QC) are employed throughout the final status survey process to ensure that all decisions are made on the basis of data of acceptable quality. As described above, the DQO process would be followed in the design of surveys and in the specification of measurement types and instrumentation. A Quality Assurance Project Plan (QAPP) will be prepared that will cover all project QA/QC requirements and activities, as well as project DQOs.

Data quality indicators (DQIs) are quantitative and qualitative measures of the reliability of the selected measurement methods. Such indicators include the inherent accuracy, precision, representativeness, completeness, and comparability of the data. Measurement instruments and methods will be evaluated in terms of these indicators when they are selected for surveys. DQIs will be included in the QAPP.

A quality assurance program will be carried out during surveys that, in accordance with the QAPP, will specify and measure the performance of measurement methods through the collection of an appropriate number or frequency of QC samples. Such samples could include blanks, replicates, and spiked samples, as well as measurements in reference areas. Field instruments will be calibrated on NIST-traceable standards at a frequency prescribed in the QAPP. Twice-daily response checks will be performed for all field instruments before use. Corrective actions will be carried out if performance falls outside expected ranges.

In addition, QA/QC measures will ensure that trained personnel carry out surveys with approved QAPP procedures and properly calibrated instruments. Procedures would cover sample documentation, chain of custody, field and laboratory QC measurements, and data management.

6 COMPLIANCE WITH THE RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION OR RELEASE

The licensee needs to clearly present in the LTP the radiological criteria proposed for license termination or release. The licensee should describe the methods used to demonstrate compliance.

6.1 Site Release Criteria

The release criteria for the SEDA site will correspond to the dose criterion of 10 mrem/yr (New York State TAGM 4003, 1993). According to this dose criterion, the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 10 mrem/yr.

Levels of residual radioactivity that correspond to the allowable radiation dose are calculated by analysis of various scenarios and pathways through which exposures could be reasonably expected to occur. These derived levels, or derived concentration guideline levels (DCGLs) are the concentration of residual radioactivity distinguishable from background that, if uniformly distributed throughout a survey unit, would result in a defined TEDE to an average member of a critical group. The EPA allows a TEDE of 15 mrem/yr and NRC allows a TEDE of 25 mrem/yr; for this site, a TEDE of 10 mrem/yr (a most restrictive criterion) based on the TAGM 4003 guide was selected.

License termination will require evaluation of residual radiological contamination from two sources, building surfaces and soil outside buildings, primarily near the entrances. DCGLs for both sources are calculated below, each based on a dose of 10 mrem/yr to the critical receptor. That receptor, therefore, could not receive a total dose in excess of 20 mrem/yr. Further, such dose would be reduced by at least the amount attributed to soil external gamma to the receptor while indoors, since soil beneath the buildings is not contaminated as assumed in the soil DCGL computations.

6.2 Dose Modeling Scenarios

Two scenarios (based on the guidance found in DG-4006) were considered — resident farmer and building occupancy. The resident farmer scenario was chosen to develop soil DCGLs, and the building occupancy scenario was used to develop DCGLs for buildings. The RESRAD (Version 6.1) computer code was used to model the resident farmer scenario and RESRAD-BUILD (Version 3.1) was used to model the building occupancy scenario. RESRAD (Yu et al. 1993a) and RESRAD-BUILD (Yu et al. 1994) computer codes have been developed by Argonne National Laboratory under sponsorship of the U.S. Department of Energy (DOE) for use in evaluating radioactively contaminated sites and buildings, respectively. RESRAD and RESRAD-

BUILD, both are pathway analysis models designed to evaluate the TEDE incurred by an individual who lives at a site with radioactively contaminated soil or who works in a building containing residual radioactive material.

The resident farmer scenario assumes residential use of the site. The average member of the critical group was, conservatively, assumed to be the resident farmer. The resident farmer drinks water obtained from a well located at the downgradient edge of the study area, ingests plant foods grown in a garden in the study area, ingests fish taken from a pond that is assumed to be constructed adjacent to and downgradient of the study area, and ingests meat and milk from livestock raised in the study area. All water used for drinking, household purposes, irrigation, and livestock watering is assumed to be drawn from the on-site well. It is unlikely that any other set of plausible human activities could occur on site that would result in a dose exceeding that for a resident farmer.

The building occupancy scenario assumes the residential and commercial use of the building after unrestricted release. It is assumed that the occupancy of the building would occur immediately after its release. The residual contamination is only on the building floor (based on the historical site assessment), and exposure would be calculated for a long-term chronic exposure to low levels of radiation.

6.3 Development of DCGLs for Soil

RESRAD (Yu et al. 1993a) implements the methodology described in DOE's manual for developing residual radioactive material guidelines and estimates time-integrated annual dose and excess lifetime cancer risk to an on-site resident. The code focuses on anthropogenic radioactive contaminants initially present in soil and their subsequent transport in air, water, and biological media to a single on-site receptor. The contamination is adjusted over time to account for radioactive decay and ingrowth, leaching, erosion, and mixing. The code uses an exposure pathway analysis method in which the relationship between radionuclide concentration in soil and dose to a member of a critical group is expressed as a "pathway sum." A pathway sum is the sum of products of "pathway factors," which correspond to pathway segments connecting compartments in the environment between which radionuclides can be transported or from which radiation can be emitted.

Considering the activities that occurred on the SEDA site, it is expected that any residual radioactivity would be confined to the surface soil layer. On the basis of the historical site assessment, the radionuclides associated with licensed operations are listed in Table 6-1 along with their half-lives and associated radiations. The radionuclides included are H-3, Pm-147, Pu-239, Ra-226, Ra-228, Th-228, Th-232, U-234, U-235, and U-238. DCGLs are developed for these radionuclides and their progeny in the decay chain (Sm-147, Pa-231, Ac-227, Th-230, and Pb-210).

RESRAD version 6.1 was used to develop DCGLs for the resident farmer scenario on the basis of a dose criterion of 10 mrem/yr. For this analysis, it was assumed that the site would be released for unrestricted use. The potential radiation doses resulting from nine exposure pathways in the time frame of 1,000 years were considered: (1) direct exposure from contaminants in soil, (2) internal radiation from inhalation of contaminated dust, (3) internal radiation from inhalation of emanating radon, (4) internal radiation from incidental ingestion of soil, (5) internal radiation from ingestion of plant foods grown in the study area and irrigated with water drawn from a well located at the downgradient edge of the study area, (6) internal radiation from ingestion of meat from livestock fed with fodder that is grown in the study area and irrigated with water drawn from the on-site well, (7) internal radiation from ingestion of milk

Table 6-1
List of Radionuclides, Their Half-Lives, and Associated Radiations
(gammas with collapsed energies and yields)

Principal Radionuclides	Half-Life (yr)	Associated Decay Chain	Product Radionuclide	Half-Life (yr)	Associated Radiations
H-3	12.35	-	He-3	-	Beta
Pm-147	2.6234	-	Sm-147	1.06E11	Beta, and gamma (86.4 keV, 5E-5)
Sm-147	1.06E11	-	Nd-143	-	Alpha
Ra-226+D[a]	1600	Rn-222, Po-218, Pb-214, At-218, Bi-214, Po-214, Tl-210	Pb-210	22.3	Alpha, beta, and gammas (26.7 keV, 0.138; 93.0 keV, 0.246; 481 keV, 1.27: 1530 keV, 0.679)
Pb-210	22.3	Bi-210, Po-210	Pb-206	-	Alpha, beta, and gamma (12.4 keV, 0.237: 46.5 keV, 0.0405)
Ra-228+D	5.75	Ac-228	Th-228	1.9131	Beta, and gamma (14.9 keV, 0.358: 301 keV, 0.492: 1010 keV, 0.766)
Th-228+D	1.9131	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Po-212, Tl-208	Pb-208	-	Alpha, beta, and gamma (13.6 keV, 0.314: 177 keV, 0.947; 654 keV, 0.603; 2550 keV, 0.387)
Th-232[b]	1.41E10	-	Ra-228	5.75	Alpha, few low-energy gamma (14.5 keV, 0.08; 72.1 keV, 0.0025)
U-234	2.45E5	-	Th-230	7.7E4	Alpha, few low-energy gamma (15.3 keV, 0.105; 71.3 keV, 0.00166)
Th-230	7.7E4	-	Ra-226	1600	Alpha and gammas (14.5 keV, 0.081; 82.7 keV, 0.0045)
U-235+D	7.038E8	Th-231	Pa-231	3.28E4	Alpha and gamma (16.8 keV, 1.14; 159 keV, 1.01)

Pa-231	3.28E4	-	Ac-227	21.6	Alpha and gamma (16.2 keV, 0.787; 90.9 keV, 0.00695; 283 keV, 0.13)
Ac-227	21.6	Th-227, Fr-223, Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207, Po-211	Pb-207	-	Alpha, beta, and gammas (14 keV, 0.641; 94.2 keV, 0.906; 330 keV, 0.86)
U-238+D	4.468E9	Th-234	U-234	2.45E5	Alpha and gamma (15.5 keV, 0.191; 82.7 keV, 0.102; 915 keV, 0.0146)
Pu-239	2.41E4	-	U-235	7.038E8	Alpha and low-energy gamma (16.1 keV, 0.0417; 48.8 keV, 0.00027; 187 keV, 0.00021)

[a]+D indicates that the associated radionuclides with half-lives less than 6 months are assumed to be in equilibrium with principal radionuclide.

[b]Th-232 may actually be in equilibrium with its progeny Ra-228 and Th-228, which means it can be detected from detecting either Ra-228 or Th-228.

from livestock fed with fodder that is grown in the area and irrigated with water drawn from the on-site well, (8) internal radiation from ingestion of fish from a pond downgradient from the study area, and (9) internal radiation from drinking water drawn from the on-site well.

The parameters used in the analysis are provided in Table 6-2. Any available site-specific parameter values were used, otherwise RESRAD default parameter values were used. Table 6-2 also provides the references or justification for the site-specific parameters selected.

Table 6-3 provides the calculated maximum dose-to-source concentration ratios (DSRs) and contribution of different pathways to the calculated maximum DSRs. The time when the maximum dose occurs is also provided. For H-3, Ra-226, Ra-228, Th-232, U-234, Pa-231, and Th-230 radionuclides, the maximum peak dose occurs at times other than time zero. For H-3, the time is later than zero because of the water-dependent nature of the exposure pathways involved, but for other radionuclides (Ra-226, Ra-228, Th-232, U-234, Pa-231, and Th-230), the time is later because of the buildup of the progeny. For Ra-226, the peak dose is at about 19 years because of Pb-210 buildup. For Ra-228, it is because of Th-228 buildup; for Th-232, it is because of Ra-228 and Th-228 buildup; for U-234, it is because of Th-230 and Ra-226 buildup; for Pa-231, it is because of Ac-227 buildup; for Th-230, it is because of Ra-226 buildup. For Pu-239, U-238, and U-235, dose contribution from progeny is not significant, therefore, the peak dose occurs at time zero (immediately after release of the site).

External exposure is the most dominant exposure pathway for U-238, U-235, Th-232, Th-228, Ac-227, and Ra-228. For U-234, Th-230, and Ra-226, the most dominant pathway is radon inhalation, followed by external exposure. For Pa-231 and Pb-210, plant ingestion is the dominant exposure pathway. For Pu-239, soil ingestion, followed by plant ingestion, are two dominant pathways. For H-3, water ingestion is the most dominant pathway. For Pm-147 and Sm-147, plant, meat, and soil ingestion are dominant pathways.

Uncertainty in the derivation of DSRs arises from the distribution of possible input parameter values, as well as uncertainty in the conceptual model used to represent the site. Depending on the scenario, different parameters influence the results in each case. For the purpose of this analysis, RESRAD default parameter values were used if no site-specific data were available. These default values are based on national average or reasonable maximum values. For U-238, U-235, Th-232, Th-228, and Ra-228, for which the external exposure pathway was the dominant contributor to dose, the uncertainties in parameters affecting the external exposure pathway (e.g., occupancy factor, area and thickness of the contaminated zone, shielding provided by buildings and site features) have the greatest impact on the model predictions, and parameters related to other pathways have relatively little impact. The effect of the occupancy factor (time indoor and time outdoor), area of the contaminated zone, and the external gamma shielding factor are discussed in Table 6-4. The values used for these parameters (occupancy factor, area of contamination, and external gamma shielding factor) would result in conservative dose values compared with DandD model (Wernig et al. 1999) default values. For these radionuclides, uncertainties in parameters relating to the leaching and transport of radionuclides from the contaminated zone do not affect the results (e.g., the uncertainties in soil properties, meteorological parameters, distribution coefficients, and water consumption rates). For Pa-231, Pb-210, Pm-147, Pu-239, and Sm-147, for which the plant ingestion pathway is the significant contributor to dose, the uncertainties in parameters affecting the plant ingestion pathway (e.g., plant ingestion rates and plant transfer factors) have the greatest impact on the model predictions, and parameters related to other pathways have relatively little impact. RESRAD default plant transfer factors and conservative values of plant consumption rates compared with DandD code are used in the analysis (Table 6-4). Therefore, the calculated dose for Pa-231, Pb-210, Pm-147, Pu-239, and Sm-147 is conservative. For Pu-239, soil ingestion also contributes significantly to the dose. Since, a conservative value of soil ingestion 36.5 g/yr compared with 18.625 g/yr (DandD default value for soil ingestion) (Table 6.4) is used in this analysis, therefore, soil ingestion pathway doses are conservative. Table 6-4

Table 6-2
Input Parameters Used at Seneca Army Depot Activity Site for RESRAD Analysis

Input Parameter	Unit	Default Value	User Input	Basis/Reference
Initial nuclide concentration in soil	pCi/g	NA	1 for each radionuclide	DCGLs independent of initial concentration
H-3				
Pm-147				
Pu-239				
Ra-226				
Ra-228				
Th-228				
Th-232				
U-234				
U-235				
U-238				
Distribution coefficients in contaminated, unsaturated, and saturated zones	cm^3/g			
Ac-227		20	2,400	Site specific value [a]
H-3		0	0	
Pa-231		50	2,700	
Pb-210+D		100	550	
Pm-147		-1	-1	
Pu-239		2,000	5,100	
Ra-226+D		70	9,100	
Ra-228+D		70	9,100	
Sm-147		-1	-1	
Th-228		60,000	5,800	
Th-230		60,000	5,800	
Th-232		60,000	5,800	
U-234		50	1,600	
U-235		50	1,600	
U-238		50	1,600	
Number of unsaturated zones	none	1	1	-
Water concentration				Default values used
Time since material placement	years	0	0	
Groundwater concentration	pCi/L	0	0	
Solubility limit	mol/L	0	0	
Leach rate	/year	0	0	
Use plant soil ratio	check box	No	No	
Basic radiation dose limit	mrem/yr	25	10	NYS TAGM 4003

Table 6-2 (Con't)

Input Parameter	Unit	Default Value	User Input	Basis/Reference
Calculation times	years	1, 3, 10, 30, 100, 300, 1,000	1, 3, 10, 30, 100, 300, 1,000	Default values used
Thickness of contaminated zone	m	2	0.15	Activity is only on the surface
Area of contaminated zone	m^2	10,000	10,000	Default value used
Length parallel to aquifer flow	m	100	100	Default value used
Cover depth	m	0	0	Contamination begins at the surface
Density of cover material	g/cm^3	1.5	Not used	NA
Cover erosion rate	m/yr	0.001	Not used	NA
Density of contaminated zone	g/cm^3	1.5	1.28	Site specific value [b]
Contaminated zone erosion rate	m/yr	0.001	0.00006	Site-specific value[c]
Contaminated zone total porosity	none	0.4	0.37	Site-specific value[d]
Contaminated zone field capacity	none	0.2	0.2	Default value used
Contaminated zone hydraulic conductivity	m/yr	10	291	Site-specific value[e]
Contaminated zone b parameter	none	5.3	7.75	Site-specific value[f]
Humidity in air	g/m^3	8	6.6	Site-specific value[g]
Evapotranspiration coefficient	none	0.5	0.80	Site-specific value[h]
Wind speed	m/s	2	3	Site-specific value[i]
Precipitation	m/yr	1	0.87	Site-specific value[j]
Irrigation	m/yr	0.2	0.2	Default value used
Irrigation mode	none	Overhead	Overhead	Default value used
Runoff coefficient	none	0.2	0.2	Default value used
Watershed area for nearby stream or pond	m^2	1E6	13E6	Site-specific value[k]
Accuracy for water soil computation	none	0.001	0.001	Default value used
Density of saturated zone	g/cm^3	1.5	1.28	Site specific value [b]
Saturated zone total porosity	none	0.4	0.37	Site-specific value[d]
Saturated zone effective porosity	none	0.2	0.175	Site-specific value[l]
Saturated zone field capacity	none	0.2	0.2	Default value used
Saturated zone hydraulic conductivity	m/yr	100	291	Site-specific value[e]
Saturated zone hydraulic gradient	none	0.02	0.012	Site-specific value[m]
Saturated zone b parameter	none	5.3	7.75	Site-specific value[f]
Water table drop rate	m/yr	0.001	0.001	Default value used

Table 6-2 (Con't)

Input Parameter	Unit	Default Value	User Input	Basis/Reference
Well pump intake depth (below water table)	m	10	3	Site-specific value[n]
Model: nondispersion (ND) or mass balance (MB)	none	ND	ND	Default value used
Well pumping rate	m^3 /yr	250	250	Default value used
Number of unsaturated zones	none	1	1	Default value used
Unsaturated zone thickness	m	4	1	Site-specific value[o]
Unsaturated zone density	g/cm^3	1.5	1.28	Site specific value [b]
Unsaturated zone total porosity	none	0.4	0.37	Site-specific value[d]
Unsaturated zone effective porosity	none	0.2	0.175	Site-specific value[i]
Unsaturated zone field capacity	none	0.2	0.2	Default value used
Unsaturated zone hydraulic conductivity	m/yr	10	291	Site-specific value[e]
Unsaturated zone b parameter	none	5.3	7.75	Site-specific value[f]
Inhalation rate	m^3 /yr	8.400	8,400	Default value used
Mass loading for inhalation	g/m^3	0.0001	0.0001	Default value used
Exposure duration	yr	30	30	Default value used
Indoor dust filtration factor	none	0.4	0.4	Default value used
External gamma shielding factor	none	0.7	0.7	Default value used
Indoor time fraction	none	0.5	0.5	Default value used
Outdoor time fraction	none	0.25	0.25	Default value used
Shape of the contaminated zone	none	Circular	Circular	Default value used
Fruit vegetable and grain consumption	kg/yr	160	160	Default value used
Leafy vegetable consumption	kg/yr	14	14	Default value used
Milk consumption	L/yr	92	92	Default value used
Meat and poultry consumption	kg/yr	63	63	Default value used
Fish consumption	kg/yr	5.4	5.4	Default value used
Other seafood consumption	kg/yr	0.9	0.9	Default value used
Soil ingestion	g/yr	36.5	36.5	Default value used
Groundwater ingestion	L/yr	510	510	Default value used
Contaminated fractions	none			Default values used
Drinking water		1	1	
Household water		1	1	
Livestock water		1	1	
Irrigation water		1	1	
Plant food		-1	-1	
Meat		-1	-1	
Milk		-1	-1	

Table 6-2 (Con't)

Input Parameter	Unit	Default Value	User Input	Basis/Reference
Livestock fodder intake for meat	kg/d	68	68	Default value used
Livestock fodder intake for milk	kg/d	55	55	Default value used
Livestock water intake for meat	L/d	50	50	Default value used
Livestock water intake for milk	L/d	160	160	Default value used
Livestock soil intake	kg/d	0.5	0.5	Default value used
Mass loading for foliar deposition	g/m^3	0.0001	0.0001	Default value used
Depth of soil mixing layer	m	0.15	0.15	Default value used
Groundwater fractional usage	none			Default value used
Drinking water		1	1	
Household water		1	1	
Livestock water		1	1	
Irrigation water		1	1	
Wet weight crop yield	kg/m^2			Default values used
Non-leafy		0.7	0.7	
Leafy		1.5	1.5	
Fodder		1.1	1.1	
Length of growing season	yr			Default values used
Non-leafy		0.17	0.17	
Leafy		0.25	0.25	
Fodder		0.08	0.08	
Translocation factor	none			Default values used
Non-leafy		0.1	0.1	
Leafy		1	1	
Fodder		1	1	
Weathering removal constant	1/yr	20	20	Default values used
Wet foliar interception fraction	none			Default values used
Non-leafy		0.25	0.25	
Leafy		0.25	0.25	
Fodder		0.25	0.25	
Dry foliar interception fraction	none			Default values used
Non-leafy		0.25	0.25	
Leafy		0.25	0.25	
Fodder		0.25	0.25	
Cover total porosity	none	0.4	0.4	Default values used
Cover volumetric water content	none	0.05	0.05	Default values used
Cover radon diffusion coefficient	m^2/s	2E-6	2E-6	Default values used
Building foundation thickness	m	0.15	0.15	Default values used
Building foundation density	g/cm^3	2.4	2.4	Default values used
Building foundation total porosity	none	0.1	0.1	Default values used

Table 6-2 (Con't)

Input Parameter	Unit	Default Value	User Input	Basis/Reference
Building foundation volumetric water content	none	0.03	0.03	Default values used
Building foundation radon diffusion coefficient	m^2/s	3E-7	3E-7	Default values used
Contaminated zone radon diffusion coefficient	m^2/s	2E-6	2E-6	Default values used
Radon vertical dimension of mixing	m	2	2	Default values used
Building air exchange rate	h^{-1}	0.5	0.5	Default values used
Building room height	m	2.5	2.5	Default values used
Building indoor area factor	none	0	0	Default values used
Foundation depth below ground surface	m	-1	-1	Default values used
Radon 222 emanation coefficient	none	0.25	0.25	Default values used
Radon 220 emanation coefficient	none	0.15	0.15	Default values used
Storage times of contaminated food stuff	days			Default values used
Fruits, non leafy vegetables, And grain		14	14	
Leafy vegetables		1	1	
Milk		1	1	
Meat		20	20	
Fish		7	7	
Crustacea and mollusk		7	7	
Well water		1	1	
Surface water		1	1	
Livestock fodder		45	45	

[a]Distribution coefficients values are based on soil conditions at the site. SEDA is located within one distinct unit of glacial till that covers the entire area between the western shore of lake Cayuga and the eastern shore of Lake Seneca. The till is consistent across the entire depot. The glacial tills in this area have a high percentage of silt and clay with trace amounts of fine gravel (Table E.1 of U.S. Army 2001). Table 32.1 of Yu et al. (1993b) lists distribution coefficient values for sand, loam, clay, and organic soil types, therefore, the Kd values for the clay soil type for contaminated, unsaturated, and saturated zone are used.)

[b]Density values for contaminated, unsaturated, and saturated zone are from Table 2.1 of Yu et al. (1993b). Table 2.1 of Yu et al. (1993b) lists the soil densities for six soil types; which are sand, sandy loam, silt loam, clay loam, and clay. The densities for silt loam and clay loam are the same. As described in footnote a, soil in this area have a high percentage of silt and clay; therefore, density of silt loam and clay loam is used in this analysis.

[c]The site-specific value used is from Table E.1 of U.S. Army (2001). The value was taken from Appendix A of Yu et al. (1993a) because of 2% slope at the site.

[d]The site-specific value used is from Table E.1 of U.S. Army (2001). The porosity value is determined from the samples collected on the site. The porosity values obtained from the samples ranged from 34.0 percent to 44.2 percent with an average of 37.3 percent (page 3-5 of U.S. Army 2001).

[e]The hydraulic conductivity used in RESRAD code is calculated from the geometric mean of the site wide hydraulic conductivity of 9.22E-4 cm/sec (page 3-19 of U.S. Army 2001).

[f]The site-specific value used is from Table E.1 of U.S. Army (2001). Soil specific b-parameter values for contaminated, unsaturated, and saturated zones are for the silty clay loam soil type from Table 13.1 of Yu et al. (1993b).

[g]The site-specific value used is from Table E.1 of U.S. Army (2001). There the value was taken from Figure L.1 (figure gives the absolute humidity by geographical regions) of Yu et al. 1993a.

[h]The value is calculated from the site-specific value of infiltration rate (0.18 m/yr) (Table E.1 of U.S. Army 2001 and precipitation rate (0.87 m/yr) from Table 1.1 of U.S. Army 2001 and using Equation E.4 from Yu et al. 1993a.

[i]The site-specific value used is from Table E.1 of U.S. army (2001). There the value was estimated using wind rose for Syracuse NY.

[j]The site-specific value used is from Table 1-1 of U.S. army (2001).

[k]The site-specific value used is from Table E.1 of U.S. army (2001).

[l]The site-specific value used is from Table E.1 of U.S. army (2001).

[m]The site-specific value used is from Table E.1 of U.S. army (2001).

[n]The site-specific value used is from Table E.1 of U.S. army (2001).

[o]The site-specific value used is from Table E.1 of U.S. army (2001).

Table 6-3
Maximum Dose/Source Concentration Ratios (mrem/yr per pCi/g) for the Resident Farmer Scenario at the Seneca Army Depot Activity

Radionuclides	Ac-227	Tritium	Pa-231	Pb-210	Pm-147	Pu-239	Ra-226	Ra-228	Sm-147	Th-228	Th-230	Th-232	U-234	U-235	U-238
Peak time, years	0.00E+00	9.00E-01	9.38E+01	0.00E+00	0.00E+00	0.00E+00	1.87E+01	2.30E+00	0.00E+00	0.00E+00	1.00E+03	4.98E+01	1.00E+03	0.00E+00	0.00E+00
Dose/Source Concentration Ratios for Water Independent Pathways															
External gamma exposure	1.05E+00	0.00E+00	1.06E+00	3.45E-03	2.53E-05	1.63E-04	5.26E+00	4.51E+00	0.00E+00	3.91E+00	1.30E+00	7.43E+00	5.52E-03	4.14E-01	6.84E-02
Inhalation of dust	3.68E-01	4.32E-11	3.96E-01	1.27E-03	1.92E-06	2.39E-02	1.03E-03	1.02E-02	4.16E-03	1.61E-02	9.49E-03	1.08E-01	2.52E-03	6.84E-03	6.57E-03
Inhalation of radon	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E+01	9.05E-02	0.00E+00	1.45E-01	4.87E+00	1.71E-01	2.03E-02	0.00E+00	1.05E-14
Ingestion of plant foods	5.29E-01	9.74E-10	1.91E+00	1.04E+00	3.35E-05	5.16E-02	1.22E+00	6.06E-01	6.72E-03	9.89E-03	3.26E-01	8.63E-01	4.78E-03	9.71E-03	9.77E-03
Ingestion of meat	4.85E-03	1.05E-09	9.59E-01	1.11E-01	3.07E-05	5.70E-03	8.88E-02	3.19E-02	6.16E-03	1.09E-03	2.70E-02	4.74E-02	6.46E-04	1.52E-03	1.52E-03
Ingestion of milk	7.01E-03	4.35E-10	7.63E-03	5.84E-02	4.44E-07	8.29E-05	7.82E-02	4.10E-02	8.90E-05	7.94E-05	1.99E-02	5.58E-02	1.45E-03	3.85E-03	3.88E-03
Ingestion of soil	3.99E-01	2.56E-13	6.27E-01	1.96E-01	2.52E-05	9.69E-02	1.23E-01	3.97E-02	5.06E-03	1.86E-02	4.82E-02	1.32E-01	2.81E-03	7.31E-03	7.36E-03
Dose/Source Concentration Ratios for Water Dependent Pathways															
Ingestion of water	0.00E+00	3.67E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of fish	0.00E+00	2.26E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of radon	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of plant foods	0.00E+00	2.71E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of meat	0.00E+00	8.58E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of milk	0.00E+00	2.47E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total of all pathways	2.35E+00	4.27E-03	4.96E+00	1.41E+00	1.17E-04	1.78E-01	2.91E+01	5.33E+00	2.22E-02	4.10E+00	6.60E+00	8.81E+00	3.80E-02	4.43E-01	9.75E-02

Table 6-4
Comparison of DandD Behavioral Parameters with Parameters Used in this RESRAD Dose Estimation

Parameters	DandD[a]	RESRAD[b]	Remarks
Area of contaminated zone	2,400 m^2	10,000 m^2	Lower contaminated area used in DandD would reduce the total dose. RESRAD uses area factors to correct for external, plant, meat, and milk ingestion pathway doses for different area sources.
Irrigation rate	1.20 L/m^2*d (0.1125 m/yr)	0.0 m/yr	Water dependent pathway doses contributed to the total dose in this calculation only for H-3. The site-specific value for the irrigation rate (no irrigation at the site) was used, and the RESRAD default for the well pumping rate was used. For other radionuclides, irrigation rate and well pumping rate will not affect the calculated total dose.
Well pumping rate	118,000 L/y (118 m^3/yr)	250 m^3/yr	
Indoor breathing rate	0.9 m^3/h		RESRAD uses one breathing rate compared with three activity-specific breathing rates specified in DandD. DandD inhalation rate of 8,578 m^3/yr is calculated by using the default inhalation rate and time fractions. DandD inhalation rate is ~2% higher and would increase pathway doses accordingly. Radon inhalation is dominant only for U-234 and Ra-226, but NRC does not include radon inhalation pathway in the dose calculations.
Outdoor breathing rate	1.4 m^3/h		
Gardening breathing rate	1.7 m^3/h		
Inhalation rate	8,578 m^3/yr	8,400 m^3/yr	

Table 6-4 (Con't)

Parameters	DandD[a]	RESRAD[b]	Remarks
Time indoor	240 d/yr (0.657 yr)	0.5 yr	Total time spent at site in DandD is 0.775 compared with 0.75 in RESRAD. This change will affect the pathway doses differently. RESRAD assumes higher time outdoors and DandD assumes higher time indoors. When the receptor is outdoors, no external shielding is applied; therefore, external pathway doses would decrease if DandD defaults were used. Similarly, inhalation pathway doses, where inhalation shielding is applied when the receptor is indoors, would decrease. However, soil ingestion pathway dose would increase if time spent on-site were higher (0.775 compared with 0.75).
Time outdoor	40.2 d/yr (0.11 yr)	0.25 yr	
Time gardening	2.92 d/yr (0.008)	-	
External gamma shielding factor	0.552	0.7	Lower external gamma shielding factor in DandD code would decrease the external pathway dose. External exposure pathway is the dominant contributor to the calculated dose for U-238, U-235, Th-232, Th-228, and Ra-228. Therefore, the calculated dose is conservative.
Fruit, vegetables, and grain consumption	52.8 + 44.6 + 14.4 = 111.8 kg/yr	160 kg/yr	Lower DandD consumption rate (fruit, vegetable, grain, and leafy vegetable) would decrease the plant ingestion pathway dose. (RESRAD uses the same plant transfer factors for leafy and non-leafy vegetables). Plant ingestion pathway is important for Pu-239 and Pm-147; therefore, the calculated dose for these radionuclides is conservative.
Leafy vegetable consumption	21.4 kg/yr	14 kg/yr	

Table 6-4 (Cont'd)

Parameters	DandD[a]	RESRAD[b]	Remarks
Milk consumption	233 L/yr	92 L/yr	DandD milk consumption is 2.5 times of RESRAD value and will increase the milk ingestion pathway dose accordingly. This pathway is not a dominant pathway for any of the radionuclides considered in this analysis.
Meat and poultry consumption	39.8 + 25.3 = 65.1 kg/yr	63 kg/yr	DandD value for meat and poultry consumption is 3% higher and will increase the meat ingestion pathway dose accordingly. However, meat ingestion pathway is only important for Pm-147.
Fish consumption	20.6 kg/yr	5.4 kg/yr	Higher DandD fish consumption will increase the fish ingestion pathway dose. However, in this dose calculation, the fish ingestion pathway did not contribute significantly to dose for any radionuclide considered; therefore, this change would not affect dose calculations.
Other seafood consumption	NA	0.9 kg/yr	DandD code does not consider other seafood consumption; therefore, total dose would be less if other seafood consumption were set to zero. This change would not affect dose calculations.
Soil ingestion rate	0.05 g/d (18.25 g/yr)	36.5 g/yr	Lower soil ingestion rate in DandD will decrease the soil ingestion pathway dose. The soil ingestion is the most dominant pathway for Pu-239; therefore, the calculated dose for Pu-239 is conservative.
Drinking water intake	1.31 L/d (478.5 L/yr)	510 L/yr	Lower water intake in DandD will decrease the water ingestion pathway dose. The water ingestion pathway is the dominant pathway for H-3; therefore, the calculated dose for H-3 is conservative.

[a] Wernig et al. (1999).

[b] Yu et al. (1993a)

also compares some of the other parameters used in this analysis with DandD default parameters and the effect the latter would have on the dose calculations. This comparison shows that for this analysis, either site-specific values or most conservative values were used; therefore, the DSRs are conservative.

The DCGLs are the concentration of residual radioactivity distinguishable from background that, if uniformly distributed throughout a survey unit, would result in a dose equal to the dose limit (10 mrem/yr) to an average member of a critical group. Given a dose limit, DL, for an individual, the DCGLs can be calculated as

$$DCGLs = \frac{DL}{DSR},$$

where DSR is the dose/source concentration ratios listed in Table 6-3. Table 6-5 gives the DCGL values for single radionuclides at a dose limit of 10 mrem/yr. The sum-of-fractions rule applies when the DCGLs for decontamination of a survey unit are implemented. The summation of the radionuclide concentrations, S_i, remaining in the survey unit and divided by the DCGLs for that radionuclide should not be greater than unity, that is,

$$\sum_i \frac{S_i}{DCGL_i} < 1.$$

These DCGLs established for a large homogeneously contaminated area in a survey unit are wide-area-derived concentration levels ($DCGL_W$). For a small, isolated area of contamination (a hot spot), the allowable concentration that can remain in the survey unit may be higher than the homogenous DCGLs, depending on the size of the contaminated area. Values of the $DCGL_W$ may be scaled through the use of area factors to obtain a DCGL that gives the same dose to an individual from residual contamination over a smaller area within a survey unit. Such a value is called a $DCGL_{EMC}$, where EMC stands for elevated measurement comparison. The $DCGL_{EMC}$ is computed as the product of the applicable $DCGL_W$ and the area factor. The area factors for use with DCGL values were calculated for the residential farmer scenario. The RESRAD code was run repeatedly, by changing the contaminated area and keeping other parameters unchanged. The area factor was calculated by taking the ratio of the dose from large contaminated area (10,000 m^2) to the dose from smaller contaminated areas. Table 6-6 provides area factors for the residential farmer scenario for all radionuclides. Linear extrapolation would be used when necessary for in-between areas. Depending on the contaminants in a survey unit, the area factors for the radionuclides that would give the most conservative dose, a lowest area factor, would be chosen for the survey unit.

6.4 Development of DCGLs for Building Surfaces

The RESRAD-BUILD code is a pathway analysis model designed to evaluate the potential dose to an individual who works or lives in a building contaminated with radioactive material. It considers the releases of radionuclides into the indoor air by diffusion, mechanical removal, or erosion. The transport of radioactive material inside the building is calculated with an indoor air quality model. The model considers the transport of the radioactive dust particulates and radon progeny due to air exchange, deposition and resuspension, and radioactive decay and in-growth. Shielding material can be specified for the external gamma dose calculations between any source receptor pair. The shielding material from eight material types can be selected.

Table 6-5
Soil $DCGL_w$'s for the Residential Scenario at Seneca Army Depot Activity

Radionuclide	Wide-Area DCGLs (pCi/g)
Ac-227	4.25
H-3	2.34E+03
Pa-231	2.02
Pm-147	8.54E+04
Pu-239	5.61E+01
Ra-226	3.43E-01
Ra-228	1.88
Sm-147	4.51E+02
Th-228	2.44
Th-230	1.52
Th-232	1.14
U-234	2.63E+02
U-235	2.26E+01
U-238	1.03E+02

RESRAD-BUILD version 3.0 was used to develop DCGLs for building surfaces for contaminants of concern (Table 6-1) at the SEDA site. Six exposure pathways were included in this analysis: (1) external exposure directly from the source: (2) external exposure to materials deposited on the floor; (3) external exposure due to air submersion: (4) inhalation of airborne radioactive particulates; (5) inhalation of aerosol indoor radon progeny: and (6) inadvertent ingestion of radioactive material deposited on the surfaces of the building room.

RESRAD-BUILD requires many input parameters. These parameters describe the building. receptor location. and source configuration. Table 6-7 lists the parameters in five categories: exposure time. building specifications. receptor characteristics. shielding specifications. and source parameters. When available. site-specific data were used in the computations. When no site-specific data were available. either default values or conservative assumptions were used. Both worker and residential occupation of the building was evaluated. Conservatively. it was assumed that the building can be modeled as one room and that the source and receptor were in the same room. Therefore, many parameters related with inflow and outflow from one room to another were not required. It was assumed that there was no shielding between the source and receptor. and the receptor was at the center of the source at a height of 1 m. The whole floor of the room was assumed to be contaminated, and the contamination was confined to a surface layer.

Table 6-6
Area Factors for Resident Farmer Scenario for Different Contaminants at Seneca Army Depot Activity

	Area Factor for Contaminant of Concern														
Area of Contamination (m2)	Ac-227	H-3	Pa-231	Pb-210	Pm-147	PU-239	Ra-226	Ra-228	Sm-147	Th-228	Th-230	Th-232	U-234	U-235	U-238
10,000	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3,000	1.0	1.1	1.2	1.1	1.2	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.1	1.0	1.1
1,000	1.1	1.1	1.2	1.1	1.3	1.1	1.0	1.1	1.4	1.1	1.0	1.1	1.1	1.0	1.1
300	1.6	1.8	2.4	3.7	2.7	2.9	1.1	1.3	3.4	1.2	1.1	1.3	1.3	1.1	1.4
100	2.0	5.4	3.5	10.9	4.0	6.0	1.1	1.4	5.8	1.3	1.1	1.4	1.4	1.2	1.6
30	2.6	18.3	5.0	34.7	5.7	10.2	2.9	1.9	8.5	1.7	3.0	1.9	3.6	1.6	2.0
10	3.5	49.2	7.0	94.2	8.1	13.7	6.4	2.8	10.5	2.5	6.9	2.8	7.2	2.2	2.9
3	6.0	167.4	12.1	270.4	16.0	16.9	16.6	5.9	12.4	5.3	17.9	5.8	11.8	4.5	5.6
1	9.8	497.3	19.5	646.0	31.5	19.6	42.4	13.7	14.2	12.3	45.8	13.2	13.6	9.9	11.0

Table 6-7
RESRAD-BUILD Input Parameters for DCGL Development at Seneca Army Depot Activity

Parameter	Units	Value	Rationale
Building Parameters			
Number of rooms	NA	1	Conservative because source and receptor are in the same room.
Deposition velocity	m/s	0.01	Default value.
Resuspension rate	1/s	5E-07	Default value.
Building exchange rate	1/h	0.8	Default value.
Room area	m^2	10, 36, 200, 600, 2,000	Room sizes could be different; therefore, calculations are done for different room areas to approximate any room configuration in a survey unit
Room height	m	2.5, 3, 4	Room sizes could be different; therefore, calculations are made for three room heights to approximate any room configuration in a survey unit.
Source Parameters			
Number of sources	NA	1	Assumes one source.
Source geometry	NA	Area	Contamination is only on the floor surface.
Source size (area)	m^2	10, 36, 200, 600, 2,000	Source size is always equal to the room area because the floor is assumed to be contaminated.
Source location	NA	0,0,0	Source is located at the center of the room at a height of 1 m from the receptor.
Air Release fraction	NA	0.1	Default value, 10% of the removable contamination is in the respirable range.
Direct ingestion rate	1/h	0	Default value.
Source removable fraction	NA	0.1	10% of the total activity is removable. (The default parameter value for loose fraction for the NUREG/CR-5512 building occupancy scenario is 0.1)
Time of source removal	days	3,650	Time of source removal is set at 3,650 days, i.e., removable part of the activity will be gone in 10 years. (This value of 10 years is about three times less than the most likely value of the parameter [10,000 days] developed at Argonne [NUREG/CR-6697]. The lower value selected is more conservative and will result in higher inhalation pathway dose)
Radon release fraction	NA	0.1	Default value

Radionuclides	NA	Ac-227, Pa-231, H-3, Pm-147, Ra-226, Ra-228, Sm-147, Th-228, Th-230, Th-232, U-234, U-235, U-238, and Pu-239	All radionuclides of concern at Seneca Army Depot Activity.
Concentration	pCi/m^2	1	Dose is first calculated for 1 pCi/m^2 surface activity and is divided by 0.0222 to calculate dose from 1 dpm/100 cm^2 surface activity.

Table 6-7 (Con't)

Parameter	Units	Value	Rationale
Shielding Parameters			
Thickness	cm	0	Most conservative assumption because it provides no shielding for the external exposure pathway.
Density	g/cm^3	2.4	Not used because there is no shielding between source and receptor.
Material	NA	Concrete	Not used because there is no shielding between source and receptor.
Receptor Parameters			
Exposure duration	days	365	Exposure is likely to spread over the whole year. Most conservative to get yearly dose.
Evaluation times	years	0, 1, 2, 10, 20, 30, 40, 50, 60, 70, 80, 90	Calculations are done at different times likely to give the maximum dose within the building life of 100 years.
Number of receptors	NA	1	Only one receptor likely to get the maximum dose.
Indoor time fraction	NA	0.24, 0.68	For worker 40 h/wk for 52 weeks and for resident 16.3 h/d for 365 days.
Breathing rate	m^3/d	18	Worker and resident are assumed to be involved in light activities. Default value.
Secondary ingestion rate	m^2/h	0.0001	Default.
Receptor location	m, m, m	0, 0, 1	Receptor is assumed at a height of 1 m from the center of the source.

Dose was calculated for different room sizes, and the most conservative DCGL values for a survey unit would be chosen. Dose is first calculated for 1 pCi/m^2 surface activity and is divided by 0.0222 to get the dose from 1 dpm/100 cm^2 surface activity. For many radionuclides (Ac-227, H-3, Pa-231, Pm-147, Sm-147, Th-228, Th-230, U-234, U-235, U-239, and Pu-239), the maximum dose would occur immediately after the unrestricted release of the building, but for some it could be at a later time (Th-232, Ra-228, and Ra-226) due to the buildup of progeny. For Ac-227, H-3, Pa-231, Pm-147, Sm-147, Th-228, Th-230, U-234, U-235, U-239, and Pu-239, only the dose immediately after the release of the building was calculated. For Ra-226, Ra-228, and Th-232, doses at different times were evaluated to determine when the maximum would occur. It was observed that the most conservative DCGLs would be obtained if it was assumed that progeny radionuclides were in secular equilibrium with their parent radionuclides. The DCGLs for Th-232+D are computed assuming progeny (Ra-228+D and Th-228+D) are in secular equilibrium with Th-232+D at the time of unrestricted release. Similarly for Ra-226+D, the DCGLs are computed assuming the progeny (Pb-210+D) is in secular equilibrium with Ra-226+D.

Table 6-8 provides the DCGL values for the residential use of the building at a dose limit of 10 mrem/yr for different room sizes. If the buildings is to be used for commercial use, the DCGL value would be 2.83 times (0.68/0.24) higher because of the lower occupancy under the commercial worker scenario compared with the residential use scenario. The values in Table 6-8 are for a single radionuclide at a dose limit of 10 mrem/yr. The sum-of-fractions rule applies when the DCGLs for decontamination of a survey unit are implemented. It was observed that the maximum dose would occur for a room size that has maximum floor area and minimum height. There are two reasons for this. First, the external exposure and deposition pathway doses increase with floor area and are at their maximum when the contamination is on a larger floor area. Second, as the room height increases, all pathway doses, except external exposure dose, decrease. The external pathway is independent of room height. All pathways except the external exposure pathway give maximum dose with the smaller room height because they depend on the air concentration in the room, which is at maximum value when the height is the smallest.

Table 6-9 gives the percentage dose contribution of different pathways for each radionuclide at the time of maximum dose for the most conservative DCGL values. Most important pathways were also identified. The inhalation exposure pathway dominated for Ac-227, Pa-231, Pm-147, Sm-147, Th-230, Th-232+D, U-234, U-235, U-238, and Pu-239. The external exposure pathway was the dominant pathway for Ra-226+D, and ingestion and inhalation were important for H-3.

Table 6-8
Building Surface $DCGL_w$'s (dpm/100 cm^2) at a Dose Limit of 10 mrem/yr for the Building Occupancy Scenario at the Seneca Army Depot Activity

	Guideline Levels for Different Room Areas, Room Height = 2.5 m				
Radionuclide[a]	**10 m^2**	**36 m^2**	**200 m^2**	**600 m^2**	**2,000 m^2**
Ac-227	1.35E+02	1.35E+02	1.35E+02	1.35E+02	1.34E+02
H-3	3.58E+09	3.58E+09	3.58E+09	3.58E+09	3.58E+09
Pa-231	6.17E+02	6.15E+02	6.15E+02	6.13E+02	6.13E+02
Pm-147	2.93E+07	2.83E+07	2.69E+07	2.60E+07	2.48E+07
Pb-210	2.13E+04	2.13E+04	2.11E+04	2.11E+04	2.09E+04
Ra-226	8.77E+03	5.71E+03	3.74E+03	3.05E+03	2.54E+03
Ra-226+Pb-210	6.22E+03	4.50E+03	3.18E+03	2.67E+03	2.27E+03
Ra-228	6.75E+03	5.30E+03	4.01E+03	3.46E+03	3.00E+03
Sm-147	1.16E+04	1.16E+04	1.16E+04	1.16E+04	1.16E+04
Th-228	1.90E+03	1.75E+03	1.57E+03	1.48E+03	1.38E+03
Th-230	2.66E+03	2.66E+03	2.66E+03	2.66E+03	2.66E+03
Th-232	5.26E+02	5.26E+02	5.25E+02	5.25E+02	5.24E+02
Th-232+Ra-228+Th-228	3.88E+02	3.76E+02	3.58E+02	3.48E+02	3.37E+02
U-234	6.55E+03	6.55E+03	6.55E+03	6.55E+03	6.55E+03
U-235	6.65E+03	6.36E+03	6.00E+03	5.78E+03	5.55E+03

U-238	7.25E+03	7.18E+03	7.12E+03	7.05E+03	7.00E+03
Pu-239	1.98E+03	1.98E+03	1.98E+03	1.98E+03	1.98E+03
	Room Height = 3 m				
	10 m²	**36 m²**	**200 m²**	**600 m²**	**2,000 m²**
Ac-227	1.61E+02	1.61E+02	1.61E+02	1.60E+02	1.60E+02
H-3	4.25E+09	4.25E+09	4.25E+09	4.25E+09	4.25E+09
Pa-231	7.38E+02	7.38E+02	7.35E+02	7.35E+02	7.35E+02
Pm-147	3.36E+07	3.23E+07	3.05E+07	2.93E+07	2.79E+07
Pb-210	2.55E+04	2.53E+04	2.51E+04	2.50E+04	2.49E+04
Ra-226	9.06E+03	5.84E+03	3.80E+03	3.09E+03	2.56E+03
Ra-226+Pb-210	6.68E+03	4.75E+03	3.30E+03	2.75E+03	2.32E+03
Ra-228	7.14E+03	5.54E+03	4.14E+03	3.56E+03	3.08E+03
Sm-147	1.39E+04	1.39E+04	1.39E+04	1.39E+04	1.39E+04
Th-228	2.04E+03	1.88E+03	1.67E+03	1.56E+03	1.46E+03

Th-230	3.19E+03	3.19E+03	3.19E+03	3.19E+03	3.19E+03
Th-232	6.31E+02	6.31E+02	6.29E+02	6.29E+02	6.27E+02
Th-232+Ra-228+Th-228	4.51E+02	4.34E+02	4.12E+02	3.98E+02	3.83E+02
U-234	7.87E+03	7.87E+03	7.84E+03	7.84E+03	7.84E+03
U-235	7.87E+03	7.50E+03	7.00E+03	6.69E+03	6.38E+03
U-238	8.67E+03	8.60E+03	8.47E+03	8.41E+03	8.31E+03
Pu-239	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03
	Room Height = 4 m				
	10 m^2	**36 m^2**	**200 m^2**	**600 m^2**	**2,000 m^2**
Ac-227	2.13E+02	2.13E+02	2.11E+02	2.11E+02	2.09E+02
H-3	5.59E+09	5.59E+09	5.59E+09	5.59E+09	5.59E+09
Pa-231	9.82E+02	9.82E+02	9.78E+02	9.78E+02	9.74E+02
Pm-147	4.20E+07	4.01E+07	3.73E+07	3.55E+07	3.34E+07
Pb-210	3.36E+04	3.34E+04	3.31E+04	3.28E+04	3.26E+04

Ra-226	9.49E+03	6.00E+03	3.87E+03	3.14E+03	2.60E+03
Ra-226+Pb-210	7.40E+03	5.09E+03	3.46E+03	2.86E+03	2.40E+03
Ra-228	7.74E+03	5.90E+03	4.34E+03	3.71E+03	3.19E+03
Sm-147	1.85E+04	1.85E+04	1.85E+04	1.85E+04	1.85E+04
Th-228	2.28E+03	2.07E+03	1.83E+03	1.69E+03	1.57E+03
Th-230	4.25E+03	4.25E+03	4.25E+03	4.25E+03	4.24E+03
Th-232	8.41E+02	8.41E+02	8.38E+02	8.35E+02	8.35E+02
Th-232+Ra-228+Th-228	5.69E+02	5.43E+02	5.08E+02	4.87E+02	4.66E+02
U-234	1.05E+04	1.05E+04	1.05E+04	1.05E+04	1.05E+04
U-235	1.03E+04	9.65E+03	8.81E+03	8.35E+03	7.87E+03
U-238	1.15E+04	1.14E+04	1.12E+04	1.10E+04	1.09E+04
Pu-239	3.18E+03	3.18E+03	3.18E+03	3.18E+03	3.18E+03

[a] It was found that doses for Th-232 and Ra-226 were occurring at later times (other than time zero). Therefore, for Th-232 and Ra-226 it would be assumed that short-lived progeny (Ra-228 and Th-228 for Th-232 and Pb-210 for Ra-226) are in equilibrium at time zero. Dose from unit concentration of progeny would be added to the parent nuclide to get the DCGLs. For Th-232+D (Th-232+Ra-228+Th-228) and Ra-226+D (Ra-226+Pb-210), this assumption would give the most conservative DCGLs.

6.5 Demonstration of Compliance with Site Release Criteria

To demonstrate compliance with the 10 mrem/yr criterion, derived concentration guideline values are developed for all radionuclides of concern at the SEDA site for soil and building surfaces. In practice, all radionuclides may not be present in a survey unit. For example, in Building 612, contaminants of concern are U-234, U-235, and U-238; whereas, in storage bunker A-701, only Pm-147 was handled. Therefore, to demonstrate compliance, DCGLs only of radionuclides of concern in a survey unit would be considered in the conversion and interpretation of field instrument readings. If individual radionuclides are assayed, using spectrometric measurements for example, DCGLs would be interpreted using the unity rule to assure compliance.

Table 6-9
Percentage Contribution of Different Pathways to the Total Dose for the Most Conservative DCGL Values for the Building Occupancy Scenario at Seneca Army Depot Activity

Radionuclide[a]	External	Deposition	Immersion	Inhalation	Radon	Ingestion
Ac-227	1.15	0.00	0.00	98.27	0.00	0.58
H-3	0.00	0.00	0.00	36.13	0.00	63.87
Pa-231	0.67	0.00	0.00	97.29	0.00	2.03
Pm-147	18.80	0.02	0.00	75.86	0.00	5.33
Pb-210	2.60	0.00	0.00	53.14	0.00	44.26
Ra-226	91.30	0.10	0.00	2.61	4.87	1.12
Ra-226+Pb-210	81.71	0.09	0.00	8.07	4.35	5.78
Ra-228	71.27	0.07	0.00	14.61	12.89	1.17
Sm-147	0.00	0.00	0.00	98.96	0.00	0.66
Th-228	34.75	0.03	0.00	32.76	32.26	0.20
Th-230	0.08	0.00	0.00	99.40	0.00	0.45
Th-232	0.72	0.00	0.00	98.73	0.09	0.45
Th-232+Ra-228+Th-228	16.93	0.01	0.00	73.21	9.37	0.47
U-234	0.17	0.00	0.00	99.26	0.00	0.57
U-235	21.23	0.02	0.00	78.50	0.00	0.46

U-238	4.64	0.01	0.00	94.95	0.00	0.58
Pu-239	0.03	0.00	0.00	97.32	0.00	2.15

[a] For Ac-227, Pa-231, Pm-147, Pu-239, Sm-147, Th-230, Th-232+D, U-234, U-235, and U-238, the inhalation pathway is the major contributor to the dose. For Ra-226+D, the external exposure pathway is dominant contributor to the dose. For H-3, the ingestion pathway is dominant.

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APPENDIX C

Instrument Procedures and Field Survey Forms
(See the SOPs in Appendix D for detailed instrument procedures)

GAMMA RADIATION SURVEYS

Use of the FIDLER

This procedure is designed to serve as a generic guide for the use of the FIDLER in both the scanning and direct measurement modes.

1. Visually inspect the instrument for damage.

2. Verify that the source check for the day has been performed.

3. Verify the calibration is current.

4. Make sure the channel switch is set to the "OUT" position.

5. The time constant can be changed by switching the response time switch between slow, medium and fast. Scanning surveys will be performed using this switch in the "SLOW" position.

6. Observe the flag values and be aware of any reading approaching this value.

7. When using the instrument, hold the detector one-foot (or selected distance) away from the surface being surveyed.

8. Survey at a rate of about one-foot per second.

9. Document scanning results as a range between the minimum and maximum count rate observed. Any significant increases in count rate must be investigated as a potential "hot spot."

10. Do not use the FIDLER to perform surveys in environments below 35 degrees F.

11. Perform direct readings by holding the probe one-foot (or selected distance) from the surface being surveyed directly above the grid center. Push the button on the top of the count rate meter to start the count. Maintain the probe in position for the entire 1-minute (or designated) count time.

12. The only user serviceable parts of this instrument/detector combination are the batteries. No other modifications shall be made to the instrument.

13. When performing scanning surveys, select the proper range to obtain a meter reading between 10 and 90% of full-scale reading.

14. Record all readings on the field survey form. If readings exceeding the flag value the hotspot survey form should be completed.

15. If the count rate drops to zero, the instrument has quit working. Stop surveying and investigate the cause of the failure. If a satisfactory explanation can not be found, the data taken since the last source check shall be considered not valid.

16. Any failure of the instrument to pass a source count at mid-day or the evening will invalidate any measurements taken after the previous successful source.

17. Turn the instrument off at the end of the day or when not being used for extended periods to conserve battery life.

ALPHA/ BETA RADIATION SURVEYS

Ludlum model 43-37 Floor Monitor with the Ludlum 2360 count-rate meter

This procedure is designed to serve as a generic guide for the use of the Floor Monitor in both the scanning and direct measurement modes.

1. Visually inspect the instrument for damage.

2. Verify that the source check for the day has been performed.

3. Verify the calibration is current.

4. Verify the proper flow of counting gas by observing the rotometer next to the P-10 gas bottle. Proper flow during operation is between 30 and 40 cc/min.

5. Observe the flag values and be aware of any reading approaching this value.

6. Set the detector height to 1 cm above the floor using a pre-measured block to ensure accuracy.

7. Perform scanning surveys with the toggle switch set to the alpha – beta mode. Turn the volume on and listen for an increase in either alpha or beta count rates. Any significant increases in count rate should be investigated as a potential "hot spot". Document the minimum and maximum scanning results

8. Survey rates will not exceed one probe width per second.

9. When performing scanning surveys select the proper range in the count-rate meter to obtain a meter reading between 10 and 90% of the full-scale reading.

10. Do not survey over sharp objects, as they may puncture the mylar.

11. Perform direct readings holding the Floor Monitor stationary. Push the button on the top of the count-rate meter to begin the scalar count.

12. Record all readings on the field survey form. Flip the toggle switch on the count-rate meter to alpha to get the alpha only measurement; flip the toggle switch on the count-rate meter to beta to get the beta only measurement. If readings exceeding the flag value the hotspot survey form should be completed.

13. If the count-rate meter appears to be misfuntioning (i.e. there are no beta counts, or the number of counts is excessive) inspect the instrument to verify that it is functioning properly.

14. The only serviceable parts of the Floor Monitor are the batteries, the mylar window, and the P-10 gas bottle. If the mylar window is replaced or repaired, it must be functioned checked to ensure that it is functioning properly.

15. Any failure of the instrument to pass a function check will invalidate any measurements collected after the previous function check unless compensating measurements demonstrating the instrument was working properly are documented and approved by the health physicist (i.e. it is documented in the field book when a mylar was punctured and no more reading were collected, the previous measurement can be accepted)

16. Turn the Floor Monitor off at the end of the day or when not being used for extended periods to conserve battery life.

17. Close the P-10 gas bottle at the end of the day

Ludlum model 43-68 handheld Plastic Scintillator Probe (Phoswich)

This procedure is designed to serve as a generic guide for the use of the Phoswich in both the scanning and direct measurement modes.

1. Visually inspect the instrument for damage.

2. Verify that the source check for the day has been performed.

3. Verify the calibration is current.

4. Observe the flag values and be aware of any reading approaching this value.

5. When collecting readings the detector should be held 1 cm above the surface.

6. Perform scanning surveys with the toggle switch set to the alpha + beta mode. Turn the volume on and listen for an increase in either alpha or beta count rates. Any significant increases in count rate should be investigated as a potential "hot spot". Document the minimum and maximum scanning results

7. Survey rates will not exceed one probe width per second.

8. When performing scanning surveys select the proper range in the count-rate meter to obtain a meter reading between 10 and 90% of the full-scale reading.

9. Do not survey over sharp objects, as they may puncture the mylar.

10. Perform direct readings holding the Phoswich stationary. Push the button on the top of the count-rate meter to begin the scalar count.

11. Record all readings on the field survey form. Flip the toggle switch on the count-rate meter to alpha to get the alpha only measurement; flip the toggle switch on the count-rate meter to beta to get the beta only measurement. If readings exceeding the flag value the hotspot survey form should be completed.

12. If the count-rate meter appears to be misfuntioning (i.e. there are no beta counts, or the number of counts is excessive) inspect the instrument to verify that it is functioning properly.

13. The only serviceable parts of the Phoswich are the batteries and the mylar window. If the mylar window is replaced or repaired, it must be functioned checked to ensure that it is functioning properly.

14. Any failure of the instrument to pass a function check will invalidate any measurements collected after the previous function check unless compensating measurements demonstrating the instrument was working properly are documented and approved by the health physicist (i.e. it is documented in the field book when a mylar was punctured and no more reading were collected, the previous measurement can be accepted)

15. Turn the Phoswich off at the end of the day or when not being used for extended periods to conserve battery life.

EXPOSURE RATE SURVEYS

Bicron Micro-Rem Meter

1. Visually inspect the instrument for damage.

2. Verify that the source check for the day has been performed.

3. Verify the calibration is current. Visually inspect the instrument for damage.

4. Verify that the source check for the day has been performed.

5. Verify the calibration is current.

6. Observe the flag values and be aware of any reading approaching this value.

7. The instrument is temperature sensitive. Do not us it to perform surveys in environments below 45 degrees F.

8. Set the response time to slow response. This will minimize the range of meter movement and provide the most precise values.

9. When performing surveys, select the proper range to obtain a meter reading between 10 and 90% of full-scale reading.

10. Take all reading at 1 foot from the survey location with the window facing the survey location.

11. Hold the instrument in place for a minimum 20 seconds before taking the reading.

12. Any failure of the instrument to pass a function check will invalidate any measurements collected after the previous function check unless compensating measurements demonstrating the instrument was working properly are documented and approved by the health physicist

13. Turn the Micro-Rem meter off at the end of the day or when not being used for extended periods to conserve battery life.

Building Number:	
Room Number:	
Surface:	
Crew:	

Radiation Survey Sheet
Seneca Army Depot
Parsons Engineering Science

Date:	
Sheet	of

Instrument			H=		Fidler					H=		H=		Fidler w/ 2350		Micro-rem			
Instrument S/N			F=							F=		F=							
Units																			
Grid	Materia	F / H	Alpha/Beta Scanning	Date	Gamma Scanning	date	Hot Spot	Grid	Materia	Alpha Direct	Date	Beta Direct	Date	Gamma Direct	Date	Exposure Rate	Date	Smears	

Materials:	C	concrete bare		WP	wood painted	G	Glass		T	Tile
	CP	concrete painted		S	wall board bare	L	Linoleum		M	Metal
	W	wood		SP	wall board painted	D	Dirt		CT	Ceiling Tile

SEAD-12 Building Hot Spot Sheet
Seneca Army Depot
Parsons Engineering Science

Building Number:	
Room Number:	
Surface:	
Crew:	

Date:	
Sheet	of

Instrument			F= Floor Monitor H= Hand Held				Filder w/ 3250		Micro-Rem				
Instrument S/N													
Units													
Grid	Location	Material	Alpha Direct	Date	Beta Direct	Date	Gamma Direct	Date	Exposure Rate	Date	Smear		Comments (document where in the grid the hotspot is located)

Materials:				
C concrete bare	WP wood painted	G Glass	T tile	
CP concrete painted	S wall board bare	L linoleum	M Metal	
W wood	SP wall board painted	D Dirt	CT Ceiling Tile	

Building Number:
Room Number:
Crew:

URSA Measurements

Seneca Army Depot Activity

Parsons

Date:
Sheet of

URSA Serial # = 0399AR

Fidler Serial # = B009V

Serial # =

Serial # =

Original Grid #	Description (i.e. Crane, N Wall)	Material	Am-241 (Ch 1) Gamma Scan	Date	New Grid # (location of highest scan)	Am-241 (Ch 1) Gamma Direct	Date	URSA Measurement Time (Min)	Outcome (1,2,3 or 4)	Material Sample needed? (Y or N)	Material Sample Collected? (Y or N)	Date

OUTCOMES:

1 Radionuclide is identified and quantified **BELOW** the DCGL.

2 Radionuclide is identified and quantified **ABOVE** the DCGL (Material Sample required)

3 Radionuclide is identified but not quantifies and therefore its activity in relationship to the DCGL is unknown (Material Sample required)

4 Radiolnuclide can not be identified (Material Sample Required).

Materials:									
C	concrete bare	WP	wood painted	G	Glass	T	Tile	Other:
CP	concrete painted	S	wall board bare	L	Linoleum	M	Metal	
W	wood	SP	wall board painted	D	Dirt	CT	Ceiling Tile	

ADDITIONAL COMMENTS:

APPENDIX D

Supplemental Quality Assurance Project Plan (QAPP)

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SUPPLEMENTAL QUALITY ASSURANCE PROJECT PLAN

APPENDIX D

QUALITY ASSURANCE PROJECT PLAN

D.1 PROJECT MANAGEMENT PLAN

The project management plan (PMP) has been developed for implementing the SEAD-48 (E0800 Row Pitchblende Ore Storage Igloos) work at Seneca Army Depot, NY. The PMP identifies key personnel and their responsibilities, defines the project background, describes the project, outlines a schedule for implementing the investigation, summarizes the data quality objectives (DQOs), and identifies the data management procedures.

D.1.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

The organizations who will be directly involved in the performance of the SEAD-48 will include the New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), United States Environmental Protection Agency (EPA), Seneca Army Depot Activity (SEDA), U.S. Army Corps of Engineers (USACE), Argonne National Laboratory (ANL), the Nuclear Regulatory Commission (NRC), and Parsons. The organizations, key personnel from each organization, and personnel contacts are listed in Table F.1. The project organization, including the field project team, is presented in Figure F.1.

For the SEAD-48 work, NYSDEC, NYSDOH and USEPA are the primary regulatory agencies with responsibilities for administering the Final Status Surveys. These three agencies will receive copies of the Draft, Final Draft, and Final Work Plan. All applicable communication and reports for this project will be delivered from Parsons to SEDA for delivery to NYSDEC and USEPA. NYSDEC, NYSDOH and USEPA are responsible for the final acceptance of all documents with authority under RCRA. Parsons will not communicate with or transmit documents to NYSDEC, NYSDOH, and EPA without the approval from SEDA and USACE.

SEDA is responsible for executing the SEAD-48 Final Status Surveys and has the responsibility of reviewing all supporting documents. Mr. John Cleary has been designated the Project Coordinator for SEDA.

USACE is the contracting officer's representative and technical oversight manager that acts on behalf of SEDA. USACE is responsible for approving all documents prior to the initiation of field work, releases reports, has the authority to modify the current statement of work (SOW) with Parsons, and can issue a stop work order. SEDA also has the authority to stop work if an unsafe work condition exists. Mr. Mr. Tom Enroth is the SEAD-48 project manager for USACE.

Parsons has been contracted for the SEAD-48 Final Status Surveys work at Seneca Army Depot and will be responsible for preparing documents and overall implementation of the investigation. Ms. Kathleen Kadlubak will serve as the Parsons Project Manager and will have overall responsibility for implementing the project. The Boston office of Parsons is responsible for conducting this work and will be supported by other Parsons offices as needed.

TABLE D.1

KEY PROJECT CONTACTS

SENECA ARMY DEPOT ACTIVITY

Commander's Representative **Mr. Steve Absolom** Seneca Army Depot Activity (SEDA) Building 123 5786 State Route 96 Romulus, NY 14541 Phone: (607) 869-1523 Fax: (607) 869-1251	Project Manager **Mr. John Cleary** Seneca Army Depot Activity Building 123 5786 State Route 96 Romulus, NY 14541 Phone: (607) 869-1235 Fax: (607) 869-1251

U.S. ARMY CORPS OF ENGINEERS

Project Manager **Mr. Tom Enroth** U.S. Army Corps of Engineers New York District Building 125 Seneca Army Depot Activity 5786 State Route 96 Romulus, NY 14541 Phone: (607) 868-1255 Fax: (607) 869-1251

PARSONS

Project Manager **Ms. Kathleen Kadlubak** Parsons 30 Dan Road Canton, MA 02120 Phone: (781) 401-2449 Fax: (781) 401-2043	Program Manager **Mr. Todd Heino** Parsons 30 Dan Road Canton, MA 02120 Phone: (781) 401-2229 Fax: (781) 401-2043
Project Technical Director **Mrs. Jackie Travers** Parsons 30 Dan Road Canton, MA 02120 Phone: (781) 401-2535 Fax: (781) 401-2043	Field Operations Manager **Mr. Ben McAllister** Parsons 30 Dan Road Canton, MA 02120 Phone: (781) 401-2151 Fax: (781) 401 2043

Project Health & Safety **Mr. Ron McConn** Parsons 1955 Jadwin Avenue, Suite 415 Richland, WA 99352 Phone: (509) 946-0415 Fax: (509) 946-8811	Project Health Physicist **Mr. Ron McConn** Parsons 1955 Jadwin Avenue, Suite 415 Richland, WA 99352 Phone: (509) 946-0415 Fax: (509) 946-8811
QC Systems Manager **Mr. John Hackett** Parsons 1700 Broadway, Suite 900 Denver, CO 80290 Phone: (303) 764-8774 Fax: (303) 318-9916	

ARGONNE NATIONAL LABORATORY

Project Manager
Mr. Thomas Sydelko
Argonne National Laboratories
Environmental Assessment Division
9700 South Cass Ave., Bldg. 900
Argonne, IL 60439-4832

Phone: (630) 252-3309
Fax: (630) 252-4611

ENVIRONMENTAL PROTECTION AGENCY

Project Manager
Mr. Julio Vasquez
U.S. Environmental Protection Agency
Superfund Federal Facilities Section
20 Broadway, 18th. Floor
New York, NY 10007-1866

Phone: (212)- 637-4323
Fax: (212)-637-3256

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Project Manager
Mrs. Alicia Thorne
New York Department
of Environmental Conservation
Division of Hazardous
Waste Remediation
Bureau of Eastern Remedial Action
625 Broadway 11th floor
Albany, NY 12233-7015

Phone: (518) 402-9619
Fax: (518) 402-9577

Mr. John Hackett will serve as the Quality Control (QC) Systems Manager and will be responsible for ensuring and verifying that Quality Control (QC) operations are executed effectively for project, field, and laboratory quality related activities. The QC System Manager, or designee, will verify compliance with work plans and procedures by performing field audits and/or surveillances. The QC Systems Manager will report to both the Project Manager and the Principle-in-Charge and has the authority to delegate QA/QC responsibilities and audits to qualified and trained personnel when required to fulfill QA/QC commitments and responsibilities. This includes delegation to the QC Field Coordinator for field activities and the Project Chemist for analytical and field QA/QC activities. The QC Field Coordinator reports to both the Field Operations Manager and the QC Systems Manager.

Mr. Ron McConn will serve as the Project Health and Safety (H&S) Officer (PHSO) and will review the Project H&S Plan. The PHSO will ensure that the required training has been completed and personnel records are kept for site personnel; coordinate and provide an initial training session during the kickoff meeting to provide an overview of specific Project H&S issues and will be responsible for implementing all Project H&S requirements throughout the life of the project. The PHSO will serve as a point of contact and coordinate with the Army-appointed Health and Safety Officer for safety issues. The PHSO will report to the Project Manager.

Mrs. Jackie Travers will serve as the Project Technical Director and will assist the project team in developing solutions for day-to-day technical issues concerning the project. The Technical Director will serve as both a source of corporate expertise in sampling and analyses, fate and transport of environmental contaminants and remediation techniques, as well as, identifying other resources within Parsons who have other related expertise as needed. The Project Technical Director will report to the Project Manager.

Mr. Ron McConn will serve as the Project Health Physicist and will have overall responsibility for execution of the SEAD-48 for Parsons. The Health Physicist will coordinate with the Project Manager and PHSO to ensure that all H&S radioactivity issues and employee safety requirements are addressed.

Mr. Ben McAllister will serve as the Field Operations Manager and be responsible for day to-day operation decisions during the field investigation. The Field Operations Manager will also be responsible for coordination of field activities with subcontractors, base environmental, range control, and other operations impacted by the field work, ensure compliance with the Work Plan, and coordinate variances in the Work Plan to the Project Manager. The Field Operations Manager will be responsible for implementation of the Project H&S Plan and the QAPP and identifying scheduling changes. The Field Operations Manager will report to the Project Manager but will communicate with the data users (Project Health Physicist) as needed.

Parsons staff will be assigned as field team members to implement the field investigation at the time of the investigation.

Subcontractors may include an analytical laboratory and a drilling subcontractor.

D.1.2 PROJECT BACKGROUND

For additional information on the site history of Seneca Army Depot and project background, refer to Section 1.2 and 1.3 of the Parsons document *Work Plan for E0800 Row Pitchblende Ore Storage Bunkers (SEAD-48), Seneca Army Depot, NY*, November 2002, (SEAD-48 Work Plan) An additional reference is the ANL document *Assessment of the Contamination Status of the E0800 Row Storage Bunkers at the SEAD* (November 2001; Appendix A).. These work plans have references to additional historical documents.

D.1.3 PROJECT DESCRIPTION

The specific tasks to be performed under this QAPP are addressed in Section 3.0 "Field Methodology" of the SEAD-48 Work Plan.

D.1.4 PROJECT SCHEDULE

Project scheduling is as follows:

Activity	Scheduled Due Date/Performance Period
Field Activities	April 1, 2003 through June 30 2003
Draft-Final Status Survey (FSS) Report	September 1, 2003
Agency Comments	September 30, 2003
Draft-Final – FSS Report and Comment Responses	November 14, 2003
Agency Comments	December 14, 2003
Final – FSS Report and Comment Responses	January 28, 2003

D.1.5 DATA QUALITY OBJECTIVES

The DQO process provides a systematic planning tool for establishing criteria for collecting quality field data and deriving a consistent data collection design for each of the areas being investigated. The DQO process consists of seven steps with the output from each step affecting subsequent steps. The following sections discuss the general DQO process used for optimizing and designing the sampling plans discussed specifically in the SEAD-48 Work Plan. The DQO approach was based on EPA documents entitled Data Quality Objectives Process for Superfund (EPA, 1993) and Guidance for the Data Quality Objectives Process (EPA, 1994).

D.1.5.1 State the Problem

The first step in the DQO process is to define the problem that is initiating the investigation. The investigation is being performed to verify the following:

- The buildings addressed in the SEAD-48 Work Plan meet the requirements for NRC license termination;

- The buildings addressed in the SEAD-48 Work Plan do not represent an unacceptable risk to the public, workers, or the environment; and

- The buildings addressed in the SEAD-48 Work Plan are ALARA.

A dose-based risk goal, consistent with the current New York State regulatory guidance of 10 mrem/year TEDE, is the basis for defining acceptable risk. Derived Concentration Guideline Levels (DCGLs) consistent with the dose limit of 10 mrem/yr have been developed by ANL for use in this work; refer to Section 6.0 of the ANL LTP (Appendix B) for specific details on the DCGL development. Formulas used in the calculation of Gross DCGLs and Minimum Detectable Amounts (MDA) can be found at the end of the QAPP.

D.1.5.2 Identify the Decision

The second step in the DQO process is to identify the expected remedial action that will be taken as determined from Phase II investigations. Based on site history, it is anticipated that no remedial actions will be necessary. However, minor remedial activities are described in the SEAD-48 Work Plan.

D.1.5.3 Identify the Inputs to the Decision

The third step in the DQO process is to identify the inputs required in resolving the decisions identified. Data collection is addressed in the SEAD-48 Work Plan.

D.1.5.4 Define the Boundaries of the Study

The fourth step in the DQO process is to identify the size of each survey unit, sampling density for various disposal areas and types, and potential sampling constraints that may affect sample collection or other aspects of the investigation. Section 3.0 of the SEAD-48 Work Plan provides information on the following:

- radionuclides of concern;
- survey unit classification;
- numbers of direct, scanning, and dose rate measurements;
- smear sampling;
- material sampling; and
- in-situ gamma spectroscopy measurements.

Formulas used in the calculation of Instrument Flag Values and the Minimum Number of Samples at the end of the QAPP.

D.1.5.5 Develop a Decision Rule

The fifth step in the DQO process is an important step that identifies the alternate actions that will be taken during the investigation based on encountered conditions. The types of decisions will include field sampling decisions, alternate types of sampling, and action level decisions. Section 3.3.7 of the SEAD-48 Work Plan provides information on instrument measurement flag values that will be used in the field to determine if a measurement is elevated.

D.1.5.6 Specify Limits on Decision Errors

The sixth step of the DQO process is to define the tolerable limits on decision errors. There are two types of errors (sampling design error and measurement error) that when combined are referred to as the total study error. Managing or controlling the total study error helps to control decision errors.

Sampling design errors occur when the design does not fully capture the complete extent of natural variability that exists in the environment. In most cases and at most SWMUs, this type of error must be minimized. The two types of sampling design errors consist of:

Type I - False negative: Not identifying contamination at a site and deciding that no further action is required.

Type II - False positive: Continuing to investigate a site where no contamination exists.

The acceptable sampling design error that was adopted for work described in the SEAD-48 Work Plan and the NRC License Termination Work Plan was a Type I error of 0.05 and a Type II error of 0.05.

D.1.5.7 Optimize the Sampling Design

The seventh step in the DQO process is to optimize the sampling and analysis plan for each site based on achieving the objectives of the investigation and providing the most resource effective approach. This is accomplished by reviewing the existing data and the outputs from the previous six steps. Once the design alternatives are determined, the most resource effective design that satisfies all of the DQOs can be selected. Information regarding the sampling design can be found in Section 3.0 of the SEAD-48 Work Plan. In addition, some general sampling information can be found in Section 5.5 of the ANL LTP (Appendix B).

D.1.6 SPECIAL TRAINING/CERTIFICATION

Information regarding special training requirements and/or certification can be found in Section 6.0 of the SEAD-48 Work Plan and the NRC License Termination Work Plan.

D.1.7 DATA MANAGEMENT

All field sheets, log books, and other relevant field documents (e.g., health and safety meeting sign-in sheets, personnel daily frisking forms, daily instrument check sheets) will be maintained by Parsons. In addition, all field measurements and instrument check data will be entered into an electronic database where it will also be maintained. At a minimum, 10% of the data entered into the database will be verified through a QC process.

All analytical data (e.g., smear sampling results, soil sampling results) will be maintained in electronic and hardcopy formats. In addition, analytical results will be added to the electronic database when appropriate.

All personnel radiological monitoring data will be maintained by the Project Health Physicist and the Project Health and Safety Officer.

Data Archive

Parsons performs scheduled electronic data backups of project files and performs periodic archiving of electronic media on a scheduled basis. Electronic project files are maintained on a no-fault server; a no-fault server minimizes data loss during hard-drive failure by operating and distributing data sequentially over four separate physical hard drives. Back-ups of project files on to magnetic tapes on the no-fault server are performed on a weekly basis and updated daily, Monday through Thursday, through a differential back-up. A differential back-up replaces backed-up files that are edited between each daily update differential back-up.

Electronic tape back-ups are stored in a fire proof box either at Parsons or at an off-site storage location. Weekly backups onto magnetic tape are retained for a minimum of three weeks prior to overwriting; however, the last back-up each month is retained without being overwritten.

D.2 MEASUREMENT / DATA ACQUISITION

D.2.1 SAMPLING DESIGN

Refer to the following documents:

- SEAD-48 Work Plan (Parsons; November 2002)
- Seneca Generic RI/FS Work Plan (Parsons; August 1995)
- SOP-01, Identification of Investigation Grids and Sampling Locations for Radiological Surveys and Sampling Activities in Accordance with MARSSIM
- MARSSIM (NRC; September 2000)
- ANL LTP (January 2002)

D.2.2 SAMPLING METHODS

The sampling methods that will be used during the data collection phase are addressed in the following documents:

- SEAD-48 Work Plan (Parsons; November 2002)
- Seneca Generic RI/FS Work Plan (Parsons; August 1995)
- SOP-03, Photon (Gamma and X-ray) Survey Using Scintillators for Environmental Investigations and Personnel Protection
- SOP-04, Collection, Handling, and Analysis of General Smear Samples for Environmental Investigations
- SOP-05, Surveys Using the FIDLER Detector
- SOP-06, Alpha Surveys and Static Counts for Environmental Investigations and Personnel Protection
- SOP-08, Gamma Spectroscopy Instrument Operation
- SOP-10, MicroR Dose Rate Instrument Operation
- SOP-11, Floor Monitor Operation

- SOP-13, Collection of Air Samples
- SOP-16, Beta Surveys and Static Counts for Environmental Investigations and Personnel Protection

SOPs are located at the end of the QAPP as Attachment A.

D.2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample handling and custody requirements are discussed in Section 5.0 of the "Field Sampling and Analysis Plan" found in Appendix A of the Seneca Generic RI/FS Workplan (August 1995).

D.2.4 LABORATORY ANALYTICAL REQUIREMENTS

All analytical procedures and methods used by the radioanalytical laboratory will be performed as documented in SOPs that will be provided upon work authorization. Any modifications of an SOP must be documented and approved in writing by the Parsons Project Health Physicist.

In selecting appropriate methods to prepare and analyze samples from Seneca Army Depot at an off-site laboratory, Parsons has taken into account the specific analytes of interest, the sample matrices, and the minimum detectable concentrations needed for the project. Testing methods are expected to meet or exceed the requirements listed in the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) (NRC, 2001)

D.2.5 QUALITY ASSURANCE / QUALITY CONTROL DEFINITIONS

QA is a system designed to ensure and document data reliability and to integrate quality planning, quality assessment, and quality improvement efforts. QA concerns the overall control of sample analysis and the record-keeping system necessary to ensure documentation of all activities (including trace ability, data completeness, and document security). QC defines the routine application of procedures for obtaining prescribed standards of performance during data acquisition.

All equipment will operability and source checked prior to use. In addition, control charts based on daily instrument checks will be maintained for the equipment to provide effective warnings of equipment performance deterioration. Also, all data collected will be reviewed and verified routinely by the Project Health Physicist and prior to the release of the data for use.

Duplicate soil or material samples should be taken on a routine basis (i.e., typically one every 10 soil samples) and at least one of the duplicates should be a background sample. A similar process should be applied to smear samples if a significant number are taken, except that the duplicates should be blank/background samples. These quality control samples will not be identified to the laboratory until the results of the analyses have been received. Since all materials have radioactive properties the definition of the "blank" should be taken to mean the appropriate background sample.

Additional QA/QC procedures are documented in the Seneca Generic RI/FS Work Plan.

D.2.6 FIELD INSTRUMENT TESTING, MAINTENANCE, AND CALIBRATION REQUIREMENTS

All field instruments will be tested, maintained, and calibrated according to the manufacturers' specifications and procedures outlined in the following documents:

- SEAD-48 Work Plan
- NRC License Termination Work Plan
- SOP-02, GM Pancake Probe Surveys and Static Counts for Beta and Photon Activity for Environmental Investigations and Personnel Protection
- SOP-03, Photon (Gamma and X-ray) Survey Using Scintillators for Environmental Investigations and Personnel Protection
- SOP-04, Collection, Handling, and Analysis of General Smear Samples for Environmental Investigations
- SOP-05, Surveys Using the FIDLER Detector
- SOP-06, Alpha Surveys and Static Counts for Environmental Investigations and Personnel Protection
- SOP-07, Gamma Spectroscopy Instrument Calibration
- SOP-10, MicroR Dose Rate Instrument Operation
- SOP-11, Floor Monitor Operation
- SOP-16, Beta Surveys and Static Counts for Environmental Investigations and Personnel Protection

SOPs are located at the end of the QAPP as Attachment A.

D.2.7 PREVENTATIVE MAINTENANCE

Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturers' specified recommendations and written procedures developed by the operators.

Schedules

Manufacturers' procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the laboratory to adhere to the instrument maintenance schedule and to promptly arrange any necessary service as required. Servicing of the equipment, instruments, tools, gauges, etc., will be performed by qualified personnel. Logs will be established to record maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. The logbooks will clearly document the date, description of the problem, corrective action taken, result, and who performed the work.

Records produced for laboratory instruments will be reviewed, maintained, and filed by the operators at the laboratories and by field personnel for equipment, instruments, tools, and gauges which are used at the site. The project QA/QC manager will audit these records to verify complete adherence to these procedures.

Spare Parts

A list of critical spare parts will be requested from manufacturers and identified by the operator. These spare parts will be stored for availability and use in order to reduce downtime due to equipment failure and repair.

D.3 ASSESSMENT / OVERSIGHT

All assessment and oversight issues are discussed in the "Field Sampling Analysis Plan" located in Appendix A of the Seneca Generic RI/FS Work Plan.

D.4 DATA VALIDATION AND USABILITY

The quality of the data collection process will be assessed through reviews of all measurements performed. The purpose of this section is to discuss the evaluation and assessment of QC requirements necessary to document the quality of the collected data.

D.4.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

D.4.1.1 Field Sampling Data

Field sampling data, including field logbooks and field data sheets, will be reviewed daily by the Field Health Physicist. Electronic coding on field activity forms will be reviewed daily/weekly by the QC Field Coordinator or Data and Sample Control Manager. Results of daily instrument checks will be tracked to monitor instrument performance.

D.4.1.2 Field Laboratory Data

Field laboratory data will be reviewed by the analyst. The preliminary review of the data will consist of reviewing the QA/QC data, including calibration data, to make sure QA/QC requirements have been meet.

D.4.1.3 Off-Site Laboratory Data

Prior to completion of a data package (which includes the electronic data deliverable [EDD]) all data must be thoroughly reviewed by the laboratory. The EDD and complete data package for each lot is delivered to Parsons for review.

Laboratory Review

The laboratory analysts and Quality Assurance Coordinator (QAC) review the laboratory QC analyses for each lot. Following QAC approval of the laboratory QC analyses, the analyst produces a hard-copy data package and data management produces an electronic file compatible with the DMIS. The lot data package contains all hard-copy data necessary to document the quality of the analyses following an approved data package format and is stand-alone. The DMIS transfer file is subjected to checking protocols.

The checking protocol verifies that all information entered in the electronic file complies with acceptable values for the method as determined at method validation. The purpose is to check for values that exceed method parameters (i.e., calibration range) and to eliminate possible transcription errors that may occur in data entry.

The QAC reviews all lots for completeness and DMIS acceptability. All lots exhibiting control problems (as determined by laboratory QC analyses) or errors in DMIS are technically reviewed by the QAC. The QAC review assures that the laboratory data for each lot is reported consistently with the QAPP.

Parsons Review

Parsons will complete a separate review of the analytical results. This review process is performed in three phases, contract compliance screening (CCS), hard-copy data verification, and electronic data review

D.4.2 Validation and Verification Methods

Data validation and verification methods are discussed in Section 9.2 "Data Validation" of Appendix C in the Seneca Generic RI/FS Work Plan.

APPENDIX D- MISCELLANEOUS CALCULATIONS

Calculation D.1: Gross Activity DCGL

When conducting a survey with multiple radionuclides of concern and the relative amounts of each that are present are known, it is appropriate to calculate a gross activity DCGL. A gross activity DCGL is calculated using the following MARSSIM equation:

$$Gross\ DCGL = \frac{1}{\frac{f_1}{DCGL_1} + \frac{f_2}{DCGL_2} + \frac{f_3}{DCGL_3} + \ldots} \qquad \text{Equation D-1}$$

where:

f_1 = activity fraction for isotope 1
f_2 = activity fraction for isotope 2
f_3 = activity fraction for isotope 3
$DCGL_1$ = DCGL for isotope 1
$DCGL_2$ = DCGL for isotope 2
$DCGL_3$ = DCGL for isotope 3

The activity fractions for the material are based on the isotopic makeup. As an example consider depleted uranium (DU), the three primary isotopes of depleted uranium are: 0.0006% for U-234, 0.2% for U-235, and 99.8% for U-238.

Calculation D.2: Minimum Detectable Amount (MDA)

Direct Measurements
Minimum Detectable Amounts (MDAs) for direct measurements for the alpha and beta instrumentation except for the beta phoswich (Table 3-2) were obtained from Table 6-4 of MARSSIM, which lists estimated detection efficiencies and sensitivities for U-238 for alpha and beta instruments of different sizes. No MDA was listed in MARSSIM Table 6-4 for a beta scintillator or a FIDLER detector; therefore, the calculations for the beta phoswich and FIDLER MDAs were performed using the following equation from MARSSIM:

$$Static\ MDA = \frac{3 + 4.65\sqrt{B}}{E * \frac{A}{100}} \qquad \text{Equation D-2}$$

where:

B = Background counts, in cpm.
E = Instrument detection efficiency
A = Active probe area, in cm^2.

Scanning Measurements
MDAs for scanning measurements were calculated for each instrument (Table 3-4 in the SEAD-48 Final Workplan) using the following equations from MARSSIM:

$$MDCR = d'\sqrt{b_i} \times (60/i) \qquad \text{Equation D-3}$$

$$Scan\ MDA = \frac{MDCR}{\sqrt{p}\varepsilon_i\varepsilon_s \frac{probe\ area}{100\ cm^2}}$$ Equation D-4

where:

- $MDCR$ = minimum detectable count rate (cpm)
- d' = index of sensitivity; as an example for a correct detection rate of 95% and a false positive rate of 5%, d' is equal to 3.28.
- b_i = background counts during observation interval i.
- i = scanning observation interval, equal to 1 second for gamma scanning and 5 seconds for alpha/beta scanning.
- p = surveyor efficiency, equal to 0.5.
- ε_i = instrument-specific efficiency
- ε_s = surface efficiency, equal to 0.54.

Calculation D.3: Instrument Flag Values

These instrument flag values are calculated for the Class II survey areas using the gross activity DCGL and the expected detection efficiency for the instrument. In addition, average (or, for the FIDLER, 95% upper threshold limit [UTL]) background measurements from the background data set (representing the upper range of possible background) are used. Flag values were calculated using the following equation:

$$Flag\ Value(cpm) = \left[DCGL\left({dpm}/{100\ cm^2} \right) \times \frac{probe\ area}{100}\left(cm^2\right) \times Efficiency \right] + Background\,(cpm)$$ Equation D-5

For alpha-beta scanning, an overall efficiency of 0.15 was used for both the floor monitor and the phoswich detectors. Scanning flag values were rounded to two significant figures.

Flag values corresponding to the DCGL were only calculated for the Class II survey areas. The flag values to be used for the Class III survey areas represent the upper range of background, as measurements significantly above background are not expected in the Class III survey areas. The direct and scanning measurement flag values for the Class III survey areas are equal to the background 95% UTL values.

Calculation D.4: Minimum Number of Samples

Calculating the minimum number of samples required for contaminants present in background is based on the procedure outlined in MARSSIM Section 5.5.2.2. It is important to determine the minimum number of samples to ensure that the Wilcoxson Rank Sum (WRS) test that will be performed on the data is statistically valid.

There are several steps to calculate the minimum number of samples. These steps are; 1) calculate the relative shift (Δ/σ), 2) determine the random measurement probability (P_r), 3) determine the decision error percentiles ($Z_{1-\alpha}$ and $Z_{1-\beta}$), and 4) calculate the number of samples for WRS test. Alternatively step 2 may be skipped and the number of samples found from Table 5.3 of MARSSIM once the relative shift and error percentiles are known. Each step is briefly detailed on below, further explanation can be found in MARSSIM Section 5.5.2.2:

1) Calculate the relative shift (Δ/σ)

The relative shift is calculated using the DCGL that has been determined, the Lower Bound of the Gray Region (LBGR), and the standard deviation in the contaminant level. The LBGR value is typically selected during the Data Quality Objective (DQO) process but can be initially estimated as being half the DCGL, consult MARSSIM for further information regarding this topic. The shift (Δ) is then found by subtracting LBGR from the DCGL (DCGL – LBGR).

The standard deviation (σ) in the contaminant level may be found from initial characterization efforts or can be reasonably estimated as 30% per MARSSIM guidance. The relative shift is the simply found by taking the ratio of the relative shift to the standard deviation (Δ/σ).

2) Determine the Random Measurement Probability (P_r)

Once the relative shift has been calculated, this parameter is found from Table 5.1 of MARSSIM. If the value of the relative shift does not appear in the table, the next lower value is chosen.

3) Determine the Decision Error Percentiles ($Z_{1-\alpha}$ and $Z_{1-\beta}$)

These parameters are standard statistical values and are representative of the selected error decision levels (α and β). As with the LBGR, the decision error levels are typically chosen during the DQO process. The decision error percentiles corresponding to the decision error levels can be found in Table 5.2 of MARSSIM.

4) Calculate the Number of Samples for WRS Test

The number of samples, N, is found using the following equation:

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3\,(P_r - 0.5)^2} \qquad \text{Equation E-6}$$

The value of N found using this equation is an approximation based on P_r and σ and as such, there is some uncertainty. Further there will be some missing or unusable data from any survey. Therefore, the number of samples should be increased by 20% to account for these problems. The value of N is then the minimum number of samples that must be collected from each reference/survey area pair to satisfy the WRS test. It is then recommended that the number of samples to be collected from each area be half the value of N.

Alternatively, if the values from steps 1 and 3 are known the number of samples for each area can be found in Table 5.3 of MARSSIM (value of N/2). The values in Table 5.3 of MARSSIM have been calculated per the above procedure.

Following the above procedure it was determined for SEAD-48 that the minimum number of samples needed to satisfy MARSSIM guidance and to have enough data to ensure that the Wilcoxson Rank Sum (WRS) test that will be performed on the data is statistically valid is 32 samples. That includes 16 samples from the site survey unit and 16 samples from the background survey unit. The surveys have been designed to more then satisfy the minimum number of samples necessary.

Standard Operating Procedures (SOPs) for SEAD-48
Specific Instrumentation

(Note that SOPs listed in the table of contents that are not relevant to SEAD-48 have been excluded)

PARSONS

STANDARD OPERATING PROCEDURE

FOR

ENVIRONMENTAL, SAFETY, & HEALTH ACTIVITIES

Volume 1 of 1

Maintained By:

PARSONS
Richland, Washington Office
1955 Jadwin
Richland, Washington 99352

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Datasheet Information

Guidance Documentation

Instrument Manuals

Numbering and Identification Data

Detector Configuration Number
Detector Model Designator-Detector S/N#-Source Type Designator-Expiration Date (YYMMDD format)-Sequence Number or other unique identifier (e.g., FID-34556-V-011231-

Designator Key		
Designator	Item	Type
FID	Fidler	Detector
NAI2X2	2" X 2" NaI	Detector
NAI1X1	1" X 1" NaI	Detector
ANT	Anthracene Solid State	Detector
P	Point	Source
S	Surface	Source
V	Volume	Source
Designator may be added by PHP as necessary using a similar format without revision of this procedure.		

ROI number
Atomic number (i.e., use include preceding zero for 3 digits, e.g., for hydrogen 001) of the radionuclides in order (for up to the first 3 radionuclides), a dash, then the expiration date (YYMMDD format), a dash, a sequence number or other unique identifier. (e.g., 055092-011231-1 for a Cs and U ROI). When it is operationally helpful the unique identifier could be the last number of the atomic weight of one of the radionuclides.

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1.0 PURPOSE

This procedure provides the requirements for setup and calibration of equipment for identifying gamma emitting radionuclides and surface activities using the Universal Radiation Spectrum Analyzer (URSA) with various detectors. The purpose of this procedure is to standardize the setup and calibration of this instrument system and documentation of the data to ensure that quality field measurements are obtained.

2.0 SCOPE

This procedure is applicable to the setup and calibration of the URSA system for the measurement of radioactivity and the identification of radionuclides in samples and in situ using the URSA and associated detector. Authorized by the professional health physicist responsible for the technical implementation of this activity. This procedure can only be implemented by trained and qualified personnel.

3.0 REFERENCES

1. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, Final, December 1997.
2. *URSA Universal Radiation Spectrum Analyzer Operations Manual*, *Quality Assurance Manual,* Radiation Safety Associates, Inc. 19 Pendleton Drive, PO Box 107 • Hebron, CT, 2001.
3. Knoll, Glenn F., 1989. Radiation Detection and Measurement, John Wiley & Sons, New York, New York, 1989 (ISBN 0-471-81504-7).
4. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, *Quality Assurance Manual,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.
5. QA-19.2, *Quality Assurance Procedure, Computer Software Verification and Validation, l, Quality Assurance Manual,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.
6. SOP-R-MCA-02, *Gamma Spectroscopy Instrument Operation,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.
7. Woolfolk, Steven and Ron McConn, 2001. *Guidance for Spectrum Analysis Process*, Parson Infrastructure and Technology Group, Inc., Richland, Washington, current version.

4.0 DEFINITIONS

1. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.

   The materials associated with the radiation source and any associate container including back-scatter surfaces.

2. **Mutichannel Analyzer (MCA)** is an instrument with the capability of collection of radiation flux data as a function of radiation energy when attached to a suitable detector. These instruments typically have associate hardware/software for the identification of radionuclides in addition to the assessment of detected flux.
3. **Photomultipler (PM) tube** receives light pulses from a detector and produces a current pulse proportional to the energy of the photons received by the tube and this pulse this can then be sorted and counted by equipment such as an MCA. The solid state equivalent is the photodiode.
4. **Region of interest (ROI)** is a set of spectral data peak typically associated with a radionuclide. This set of peaks is used when quantifying activity.
5. **Resolution** is a measure of the ability of the detector, photomultipler tube, and MCA system to include a discrete energy count in the appropriate MCA channel. In other words how uncertain (i.e., wide) the energy peak is. The resolution is the full width at half maximum of the full energy peak (FWHM) divided by the height of the energy peak (see Knoll, 1989).

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

5.01 The calibration source(s) used in this procedure must be National Institute of Standards and Technology (NIST) traceable standards whose calibration are current and have not been impacted by use.

5.02 The MCA and detector must have the current off-site calibrations mandated in the applicable Parsons procedures and/or the applicable project documents (e.g., Work Plan).

5.03 The URSA software must have current Verification and Validation documentation consistent with QA-19.2 or equivalent project authorized document.

5.04 Only qualified and trained personnel are allowed to operate the equipment for purpose of generation of qualified data. Note, personnel who are being trained in the operation of this equipment may generate qualified data if directly supervised by a qualified individual who co-signs the datasheets.

5.05 The instrument shall be fully functional (i.e., no indications by the software or based on expected performance from training that the system is not functioning) prior to its use, or special authorization is required by the Project Health Physicist.

5.06 **CAUTION: *Do not contact the active surface of the sources* with your skin. This can result in unnecessary radiation exposure. These contact doses are typically significantly higher than generally expected by personnel. In addition, the chemical on the skin surface may damage the source invalidating its calibration and possibly causing the release of radioactive contamination.**

5.07 The detector type, settings, serial number, cord length and the geometry listed in the URSA calibration files must be conformed to otherwise the calibration is **NOT** valid. The detector, cable, and URSA system are calibrated as a unit and may not be interchanged without recalibration.

5.08 Modeling used to establish efficiencies for various survey approaches associated with the calibration activities for the system addressed in this procedure must be fully documented in Parsons calculation (i.e., consistent with a Parsons approved Quality Assurance plan acceptable to the project) or equivalent project documentation. At a minimum two professional Health Physics must be involved in the preparation and/or review of the entire calculation.

5.09 Software used in modeling to establish efficiencies for various survey approaches associated with these calibrations must have current Verification and Validation documentation consistent with QA-19.2 or equivalent project authorized document.

5.010 Modeling and calculation used to establish efficiencies or energy spectra for various survey approaches shall have clearly established uncertainties based on sound mathematical and scientific principle and reflect consideration of statistical uncertainties, measurement uncertainties, calibration/standard uncertainties, variability due to environmental conditions, equipment bias, and propagation of errors. The consideration of uncertainty does need to address human error and equipment failure probability, which should be minimized by procedural control, training, and testing.

5.011 **URSA is designed primarily for relatively low-level measurements**, and pulse pileup starts becoming noticeable at rates of around 500,000 cpm. At rates higher than this, pileup causes the spectrum to appear to shift to the right and the low-energy response appears to diminish. If a higher activity source is used for instrument setup, it is recommended that the source be kept far enough from the detector to keep the count rate below 500,000 cpm.

6.0 RESPONSIBILITIES

6.01 Project Health Physicist (PHP) is responsible for:

(a) Ensuring that the instruments are properly maintained and calibrated at required intervals.

(b) Training the Radiological Control Technicians (RCTs) in the proper use of this instrument and providing technical supervision for the implementation of this procedure.

(c) Providing independent review of the instrument field test, operational checks, and calibration data to ensure that the data is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

(d) Verifying calibration data at the time of collection or at least prior to use of the equipment for data collection.

(e) Designating the appropriate detectors, sources, and geometry for calibration to support the completion of the project mission.

6.02 Radiological Control Technicians (RCT) are responsible for:

(a) Operating this instrument in accordance with this procedure and the applicable training and documentation.

(b) Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

(c) Documenting data collected using the instrument in accordance with appropriate regulations and procedures.

(d) Reporting instrument malfunctions or out-of-specification conditions to the Project Health Physicist and/or Field Supervisor.

The PHP and professional health physicists who have meet the training and qualification requirements established for this procedure may complete tasks designated for the RCT.

6.03 Professional Health Physicist (HP) (not the Project Health Physicist)

(a) Provide independent technical review of collect data and associated activities.

6.04 Project Manager (PM) (or designee, such as the field supervisor)

(a) Provides required materials and trained/qualified personnel for implementation of the task.

(b) Provides operational review of the project specific activities for these data collection activities.

7.0 PROCEDURES

Note: This procedure is for setup and calibration of the URSA MCA as a spectrometer with the various detectors, configurations, and geometries necessary to meet the project's mission.

Note: If at anytime during this procedure there are conditions that may impact the results note this information in the comment section of the applicable datasheet.

Note: The URSA Detector Setup & Calibration Datasheet (Exhibit 6) may be used in place of the URSA Detector Setup Datasheet(s) (Exhibit 1), URSA Detector Energy Calibration Datasheet(s) (Exhibit 2), URSA ROI Datasheet(s) (Exhibit 4), and URSA Efficiency Calibration Datasheet(s) (Exhibit 5) throughout this procedure. If the URSA Detector Setup & Calibration Datasheet (Exhibit 6) is used then the PHP authorization for use and associated signature must be delayed until the end of the task. The PHP authorization for use and associated signature authorizing use of the data is not required when several sections of this procedure are being done as one activity; although these signatures must be obtained at the end of this activity and prior to any data collection per the Gamma Spectroscopy Instrument Operation procedure, SOP-R-MCA-2. If the URSA Detector Setup & Calibration Datasheet (Exhibit 6) is used and **sections are not applicable,** these sections must be clearly **lined through, initialed,** and dated by an individual completing the datasheet.

Note: Throughout this procedure items representing specific wording on the URSA software computer screen are shown in *italics*.

Caution: A significant variation in temperature (±3° C) during the Measurement will invalidate the measurement. If there is a difference in temperature greater than ±1.5° C verify fine tuning after measurement.

7.01 Initial Setup Or Detector Addition

The operation of the URSA uses a Windows™ based interactive computer screens, the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual.

Note: When using a 60 Hertz A.C. source the power source or having the detector cable near power for the URSA may generate low level peaks every 60 keV which may impact data quality. Thus the data should be reviewed for this impact and this impact should part of the system background. Ideally the 60 Hertz interference should be eliminated if practicable.

Note: The PHP must provide routine technical oversight/supervision of this task.

1 PHP Review, as appropriate, the project/task documents (e.g., work plan), site data, Guidance for Spectrum Analysis Process, URSA manual, applicable procedures, available detectors, Current URSA Detector Configuration Log, Current URSA ROI Log, instrument documentation for previous jobs, the URSA calibration data, and/or other documents to determine appropriate and the URSA configuration to be used and the expiration date for the configuration. The information needed includes:

- Type, range of activity, and energy of projected radiation.
- The required data and the associated data quality objectives.
- Available detectors for use in collection of spectral data for the type, energy and activity of radiation projected to be present.
- Physical configuration of source and projected detect to source geometries.
- Capability to complete any required modeling necessary to support calibration and its required adequacy.
- Availability of calibration sources.
- Applicable calibration sources.
- Setup and calibration expiration dates, as appropriate.

If the activity addresses recalibration or resetup of the existing detector configuration(s) proceed to Step 6.

2 PHP Establish the configurations to support the planned activities, and add these configurations, as needed, to the Current URSA Detector Configuration Log and Current URSA ROI Log. This maybe done at any convenient time for the PHP and the changes maybe accumulated to minimize the impact on the document control system.

3. PHP Arrange for procurement of any required sources or equipment including items such as sample holders, special equipment handles, power supply sources, and support brackets. This includes verification that traceable calibration documentation for sources and equipment (as applicable) are in the record system or being transmitted to the records system. Further, that the instrument manuals are included in or being transmitted to the appropriate quality records system.

4. PHP Arrange for the completion of any required models necessary to complete this activity and update the Guidance for Spectrum Analysis Process, as needed.

5. PHP Ensure the validation of the URSA software has been completed and arrange for the installation and verification of the URSA software on the computers to be used for data collection and analysis, during this task (see QA-19.2).

6. PHP Initiate an URSA Detector Setup Datasheet(s) (Exhibit 1), URSA Detector Energy Calibration Datasheet(s) (Exhibit 2), URSA ROI Datasheet(s) (Exhibit 4), URSA Efficiency Calibration Datasheet(s) (Exhibit 5), and/or URSA Detector Setup & Calibration Datasheet(s) (Exhibit 6), as needed, then complete the first section of each.

7. PHP Provide the equipment, sources, and datasheets to the RCT assigned to complete the setup and calibration.

8. RCT Obtain the required equipment, sources, and datasheets per direction of the PHP and PM consistent with the datasheets.

9. RCT Make sure URSA is attached to the computer on COM1 or COM 2 and the detector is also connected using the appropriate type and length cable.

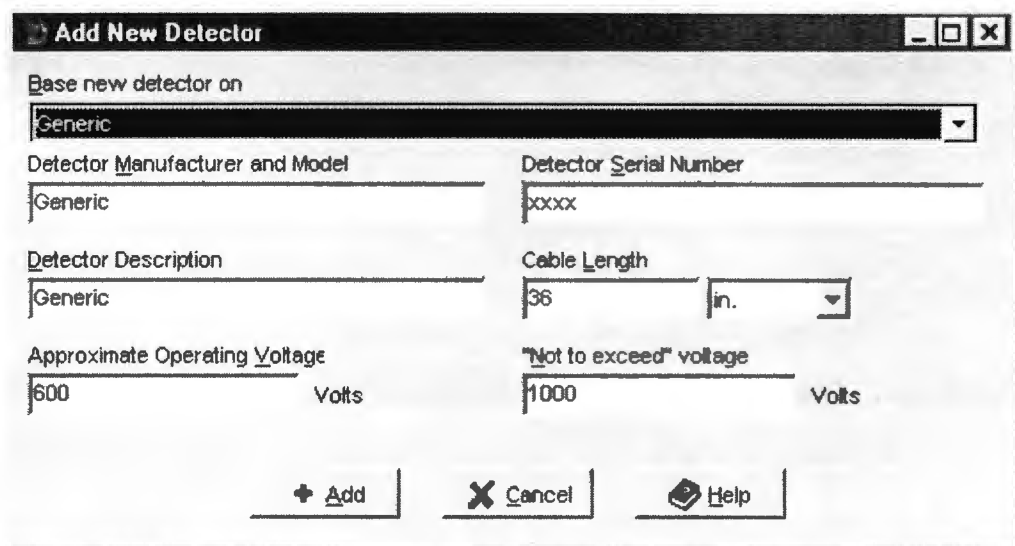
10. RCT Start the computer, turn on URSA, and start the URSA software once Windows has booted up. Do not use the off-line version of the software.

11. RCT If you are addressing an unexpired existing detector configuration go to Step 14, otherwise continue.

If this is an initial setup, a message will appear stating that you must enter a detector before URSA can be opened. Many of URSA's calibration files are tied to a specific URSA/detector combination.

Click the OK button. This will open the Add New Detector window.

12. RCT



Note: The Add New Detector window will, the first time it is used, contain some default generic data. If not you may select a detector that is close to the proposed detector to help in the input (e.g., if this is Resetup of an existing configuration select that configuration but update the expiration date in the detector description). All fields **must** contain information.

12. (cont.) RCT Add the new/updated detector information from the URSA Detector Setup Datasheet (Exhibit 1). The last portion of the *Detector Description* is the expiration date of the setup for this detector in parenthesis, as provided by the PHP. Click the *Cancel* button if you make an error otherwise, click the *Add* button after you have completed entering the information for your detector.

13. RCT If you have been instructed to add another detector respond *yes* to the screen query about adding additional detectors and repeat steps 11 and 12, otherwise enter *no*. If you are adding additional detectors the PHP must have supplied the URSA Detector Setup Datasheets (Exhibit 1) for each detector being added.

14. RCT Complete required sections of this procedure (based on PHP direction) in the following order omitting any sections that are not required.

a) The Hardware Setup (Section 7.02),
b) The Energy Calibration (Section 7.03),
c) Create the Regions of Interest (ROIs) (Section 7.04), and
d) The Efficiency Calibration (Section 7.05).

For the detector configurations specified by the PHP.

Note: If the only difference between detector systems is the geometry, then the Hardware Setup (Section 7.02) can be applied to all these similar system configurations.

7.02 Hardware Setup

The operation of the URSA uses a Windows™ based interactive computer screens, the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual.

Note: When using a 60 Hertz A.C. source the power source or having the detector cable near power for the URSA may generate low level peaks every 60 keV which may impact data quality. Thus the data should be reviewed for this impact and this impact should part of the system background. Ideally the 60 Hertz interference should be eliminated if practicable.

Note: The PHP must provide routine technical oversight/supervision of this task.

1 RCT Initiate Hardware setup specified in the URSA Detector Setup Datasheet (Exhibit 1) or URSA Detector Setup & Calibration Datasheet (Exhibit 6) and if restarting the process rather than continuing from Section 7.01, repeat steps 7 to 9 of Section 7.01.

Note: If several detector systems are being addressed and the only difference between detectors is the geometry, then the Hardware Setup (Section 7.02) can be applied to all these similar system configurations and should be record on all applicable datasheets.

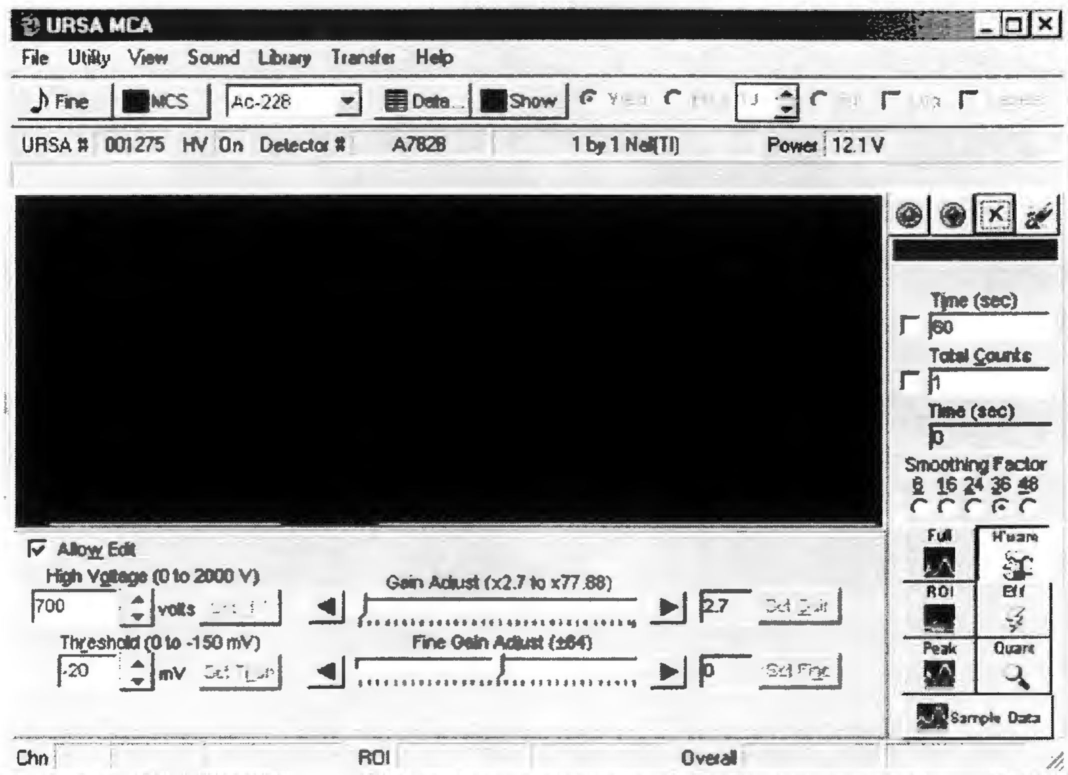
2 RCT Enter the datasheet number and then select the detector for which you are continuing setup.

3. RCT *Enable* the High Voltage, unless other instructions were supplied by the PHP, and document this in Section 2 of URSA Detector Setup Datasheet (Exhibit 1)

If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery needs to be replaced immediately) shut down URSA & computer, then sign and date the datasheet and store datasheet in accordance with applicable procedures and Project Management direction.

4. RCT Terminate all other activities on the computer.

5. RCT



Open the Hardware Panel (click the *H'ware* button towards the lower right of the display), and set the Gain to x2.7 (the lowest setting), the Threshold to –20 mV, and the Fine Gain to zero (centered) as shown above. If this is the initial setup of the detector, these should already be set to these values. If any of these values have been changed, one of the Set buttons must be clicked to apply the hardware setting.

6. RCT Click *Auto HV Plateau* from the Utility menu. This will open the URSA Auto HV Plateau window ((see Screen in Step 11))

7. RCT Check that the minimum HV is at least 200 V below your best estimate of where the operating point will be (refer to the detector datasheet and/or manufacturer's literature). Going farther below will not cause any difficulties, but the time required to determine the HV plateau will increase. Adjust the Minimum HV as needed or desired (see Screen in Step 11).

8. RCT Check that the maximum HV does not exceed the maximum operating voltage of the detector (refer to the detector manufacturer's literature). If you know that the operating voltage will be well below the detector's maximum HV, adjust this value down to reduce the time needed to perform the plateau.

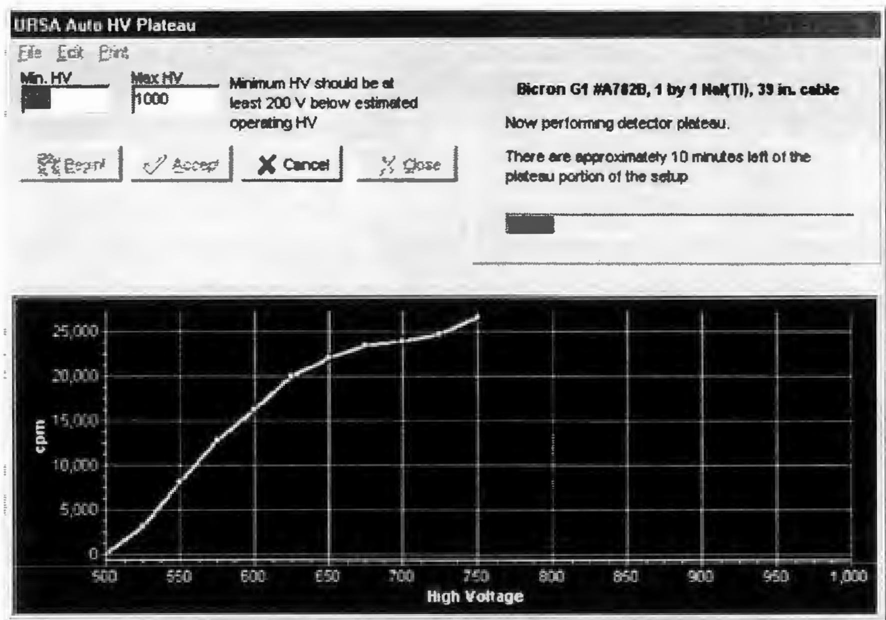
9. RCT Place a source in front of the detector. Almost any source can be used for the plateau provided the detector is sensitive to the radiation emitted and the source is of sufficient activity. A 1 μCi ^{137}Cs source (or other source designed in URSA Detector Setup Datasheet, Exhibit 1) has been found to work well for most gamma detectors.

Note: Ensure that no other applications are running.

10. RCT Click the *Begin* button (see Screen in Step 11). A warning message will appear

asking you to confirm that the detector is attached, the URSA is switched on, and the source is in front of the detector. Click the OK button.

11. RCT **Note:** The Auto Plateau will begin. A panel will display the estimated time remaining in the procedure and the chart will update as each data point is collected. The first one or two points may not be immediately visible. **Click the *Cancel* button at any time to stop the Auto HV Plateau process, if the process appears to be malfunctioning and contact PHP.**



12. RCT If the Auto HV Plateau process is cancelled before completion, the data will still be left on the graph, but the last-used HV (from URSA MCA) will be displayed on the chart. Check the *Allow Edit* box (see Screen in Step 11) to enable manual adjustment of HV.

Note: this may only be done at the direction of the PHP.

13. RCT Click on the *Accept* button (see Screen in Step 11) to change the HV used by the current detector.

14. RCT If a printer is available click *Print* and print a copy of the plateau data and curve and attach it to the URSA Detector Setup Datasheet(s) (Exhibit 1), otherwise implement Section 7.07 just prior to terminating the procedure for the shift or day.

15. RCT Click *Close* (see Screen in Step 11) to return to normal URSA MCA operation.

16. RCT Record the revised operating High Voltage on the URSA Detector Setup Datasheet(s) (Exhibit 1)

17. RCT **Prerequiste:** This portion of the procedure assumes that the detector is attached to the URSA, the URSA is switched on, the URSA MCA software has been successfully started, and a designated source (e.g., ^{137}Cs of approximately 1 μCi) is on the detector. (For the ^{137}Cs source this assumes that the detector to be used is capable of seeing both the 32 and 662 keV peaks.) It is not necessary that an Auto HV plateau has been performed.

Warning: Do **not increase the HV** (i.e., high voltage) **beyond the maximum** value for the detector.

Check *Allow Edit* box (see Step 5) is checked.

Note: Hardware settings cannot be adjusted until the *Allow Edit* box is checked.

18. RCT Set the Fine Gain set to zero (the middle value) before adjusting the hardware settings.
19. RCT Click on the *H'ware* (for hardware settings) on the URSA button panel (see Step 5). This will open the hardware settings panel along the bottom of the spectrum display.
20. RCT Ensure that the HV is set to a reasonable value and set the gain should be at x2.7 (the lowest setting) and the threshold should be at –20 mV.
21. RCT Click the Start Acquisition button to begin counting the source. Allow the source to count long enough to see the relative locations of the designated peaks (e.g., the ^{137}Cs peaks). NOTE: If excessive noise is clearly visible in the lowest portion of the spectrum, adjust the threshold farther from zero, clear the spectrum, then restart acquisition. Repeat this process as needed.
24. RCT If no peaks are visible, increase the HV and go back to step 23.
25. RCT If the designated peaks (e.g., both ^{137}Cs peaks) are not visible:
    a) If there are very few counts to the right of the visible peak but many to the left (e.g., only the 662 keV peak is visible) and it is towards the right of the spectrum display, increase the HV and go back to step 23.
    b) If there are many counts to the right of the visible peak (e.g., only the 32 keV peak is visible and the 662 keV peak is out of view to the right), decrease the HV and go back to step 23.
    c) If there are very few counts to the right of the visible peak but many to the left (e.g., only the 662 keV peak is visible) but the peak is in close to the desired location on the spectrum, adjust the threshold closer to zero and go back to step 23.
26. RCT If the designated peaks (e.g., both ^{137}Cs peaks) are visible, but are farther apart than wanted, decrease the HV and go back to step 23.
27. RCT If the designated peaks (e.g., both ^{137}Cs peaks) are visible, but are closer together than wanted, increase the HV and go back to step 23.
28. RCT If the HV is at the highest HV recommended by the detector manufacturer (or if it is higher than you are comfortable with), leave the HV where it is, increase the gain and go back to step 23.
29. RCT When the designated peaks are in their optimal locations, uncheck the *Allow Edit* box.

30. RCT Record the HV, Gain, Threshold, and Fine Tuning setting on the URSA Detector Setup Datasheet (Exhibit 1).

31. RCT Click the *Full* button from the button panel to close the Hardware Settings panel and restore the spectrum to the largest possible viewable area.

Note: Once all the hardware settings are finalized, an energy calibration can be performed.

32. RCT Records Setup Expiration Date based on the datasheet based on direction provided by the PHP, then signs and dates the URSA Detector Setup Datasheet (Exhibit 1).

33. RCT Provide a copy of the URSA Detector Setup Datasheet (Exhibit 1) to the PHP and request that the PHP sign the original.

34 PHP Review the Setup results and arranges for corrective actions as necessary or signs URSA Detector Setup Datasheet (Exhibit 1) authorizing the Setup for use.

35. PHP Arrange to update the Current URSA Detector Configuration Log (see Exhibit 3) in the SOP manual.

Note: This update may be delayed as needed to minimize the costs and impact on the records and document control system.

36. HP Implements the data verification process addressed in Section 7.06.

Note: Analyses based on this detector configuration should not be released to the customer as finalized data until the data verification process has been completed.

7.03 Energy Calibration

The operation of the URSA uses a Windows™ based interactive computer screen; the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual.

Note: When using a 60 Hertz A.C. source the power source or having the detector cable near power for the URSA may generate low level peaks every 60 keV which may impact data quality. Thus the data should be reviewed for this impact and this impact should part of the system background. Ideally the 60 Hertz interference should be eliminated if practicable.

Note: The PHP must provide routine technical oversight/supervision of this task.

Prerequiste: This section can only be **completed once Sections 7.01 and 7.02** (excluding steps 35 to 36) has been completed for the URSA detector set.

Note: The expiration of this calibration can not exceed the expiration of the Setup configuration being used.

Note: The PHP must provide routine technical oversight/supervision of this task.

1 RCT If Sections 7.02 has just be complete and the system is already setup go to Step 5, otherwise obtain the required equipment, sources, and datasheets per direction of the PHP.

2 RCT Complete the balance of the initial section of the URSA Detector Energy Calibration Datasheet(s) (Exhibit 2) including the datasheet number.

3. RCT Set up system at a location convenient for analysis, that minimizes background impacts.

4. RCT Start the computer.

5. RCT Select a detector/geometry. If the designated detector/geometry is not available or the Setup has expired, consult PHP to arrange for the addition of system configuration per 7.01 and 7.02 sections or, if qualified, implement this procedure to add detector.

7. RCT Enable *High Voltage* and verify that the *High Voltage, Gain*, and *Threshold* are consistent with the data in the URSA Detector Setup Datasheet (Exhibit 1) or the Current URSA Detector Configuration Log, If inconsistent contact the PHP for direction and note this in the comment section of the datasheet.

8. RCT If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery need to be replaced immediately) shut down URSA & computer, then sign and date the datasheet and store datasheet in accordance with applicable procedures and Project Management direction; then terminate activity.

9. RCT Record the data in Section 2 including the *High Voltage, Gain*, *Fine Gain*, and *Threshold* on the URSA Detector Energy Calibration Datasheet(s) (Exhibit 2)

10. RCT Check the *Time* block then enter the background count time and the smoothing factor (see Section 7.02, Step 5) specified by the PHP.

11. RCT Ensure the source are secured away (i.e., not contributing significantly to background) from the detector then click the *Start* button to begin data acquisition.

12. RCT Once acquisition is complete, then click on the *File* button and save the file as a background spectrum. File naming is typically the Datasheet Number followed by a unique number then LB for location backgrounds.

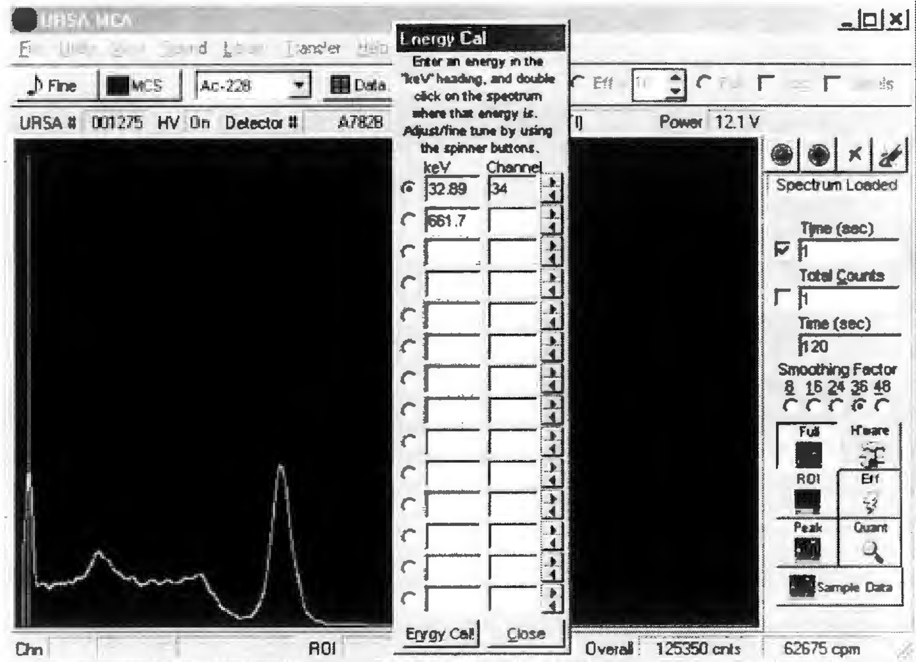
13. RCT Place a energy calibration source in the position consistent with the designated geometry, after verifying that the source is a traceable source with a current and valid calibration.

14. RCT Click the *Start* button to begin data acquisition.

15. RCT From the "*Utility*" menu, select "*Energy Calibrate…*" The energy calibration window will appear. If this is the first energy calibration for this detector, the energies for the two ^{137}Cs peaks may be present. The energy calibration window can be moved around the screen by clicking on the blue bar along the top and dragging it to the desired location.

16. RCT Assuming the sources spectrum is displayed, assign channels to the energies by:

a) Clicking the button next to appropriate keV (see datasheet). The keV box and the channel box to its immediate right will turn yellow.



b) If an appropriate energy is not shown in the box enter the appropriate keV value, otherwise continue.

c) Move the mouse cursor over the appropriate keV peak on the spectrum display and double click. A yellow line will appear on the spectrum indicating the location of this energy calibration point, and the channel number will appear in the channel box.

d) If the energy calibration point is not in the optimal location, adjust its location by double clicking in a different location, clicking on the relevant "Channel" box and entering the desired channel number using the keyboard, or using the spin buttons to the immediate right of the relevant "Channel" box to move the data point up or down one channel at a time.

17. RCT If there are additional spectral lines to be input, move to the next or the appropriate keV line and repeat Step 16.

18. RCT Click the *Enrgy Cal* button. This will perform an energy calibration based on these data points. The energy calibration window will remain open. At this point, when the cursor is moved over the spectrum display, the energy associated for the cursor location will be displayed in the spectrum status bar in addition to the status bar.

19. RCT Record the Source S/N#, energy (keV), and channel in the Energy Calibration section of the URSA Detector Energy Calibration Datasheet(s) (Exhibit 2).

20. RCT If additional peaks are to be included in the spectra from other sources repeat Steps 13 to 19.

21. RCT When finished, click the *Close* button to hide the energy calibration window.

22. RCT Record the expiration date of the energy calibration based on input from the PHP. This date cannot be after the Setup expiration date for the detector configuration from the applicable URSA Detector Setup Datasheet (Exhibit 1).

23. RCT Sign and date the datasheet.

24 RCT Implement Section 7.07 just prior to terminating the procedure for the shift or day.

25 PHP Review the Energy Calibration results and arranges for corrective actions as

necessary or signs URSA Detector Energy Calibration Datasheet(s) (Exhibit 2) authorizing the Setup for use.

26. HP Implements the data verification process addressed in Section 7.06.

Note: Analyses based on this detector configuration should not be released to the customer as finalized data until the data verification process (Section 7.06) has been completed.

7.04 Establishing ROIs

Prerequiste: Energy Calibration for the detector configuration (see Section 7.03 excluding Step 26) must be completed before this section can be completed.

Note: The operation of the URSA is based on Windows based interactive computer screen; the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual.

Note: When using a 60 Hertz A.C. source the power source may generate low level peaks every 60 Hertzs which may impact data quality, particularly for low activity data. Thus the resulting data should be reviewed for this impact and the impact should be part of the background data..

Note: The PHP must provide routine technical oversight/supervision of this task.

1. RCT If Sections 7.02 or 7.03 has just be complete and the system is already setup go to Step 12, otherwise obtain the required equipment, sources, and datasheets per direction of the PHP.
2. RCT Complete the balance of the initial section of the URSA ROI Setup Datasheet(s) (Exhibit 4) and enter the datasheet number.
3. RCT Set up system at a location convenient for analysis, that minimizes background impacts.
4. RCT Start the computer.
5. RCT Select a detector/geometry. If the designated detector/geometry is not available or the Setup has expired, consult PHP to arrange for the addition of the system configuration per sections 7.01, 7.02, and 7.03 or, if qualified, implement this procedure to add detector.
6. RCT Enable *High Voltage* and verify that the *High Voltage, Gain*, and *Threshold* are consistent with the data in the URSA ROI Setup Datasheet(s) (Exhibit 4)or the Current URSA Detector Configuration Log, If inconsistent contact the PHP for direction and note this in the comment section of the datasheet.
7. RCT If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery need to be replaced immediately) shut down URSA & computer, then sign and date the datasheet and store datasheet in accordance with applicable procedures and Project Management direction, then terminate this activity.
8. RCT Record the data in Section 2 including the *High Voltage, Gain, Fine Gain*, and *Threshold* on the URSA ROI Setup Datasheet(s) (Exhibit 4).

9. RCT Check the *Time* block then enter the background count time and the smoothing factor (see Section 7.02, Step 5) specified by the PHP.

10. RCT Ensure the source are secured away from the detector (i.e., do not contribute significantly to the background) then click the *Start* button to begin data acquisition.

11. RCT Once acquisition is complete, then click on the *File* button and save the file as a background spectrum. File naming is typically the Datasheet Number followed by a unique number then LB for location backgrounds.

12. RCT Complete the portions of Section 1 and 2 requiring additional information, consult the PHP as needed for information.

13. RCT Position the designated source in the detector configuration and then Click the *Start* button to begin data acquisition, then
   - If .*Automatic Method* of setting up and ROI is to be used go to the next step.
   - If the *Manual Method* of setting up and ROI is to be used go to Step 23.

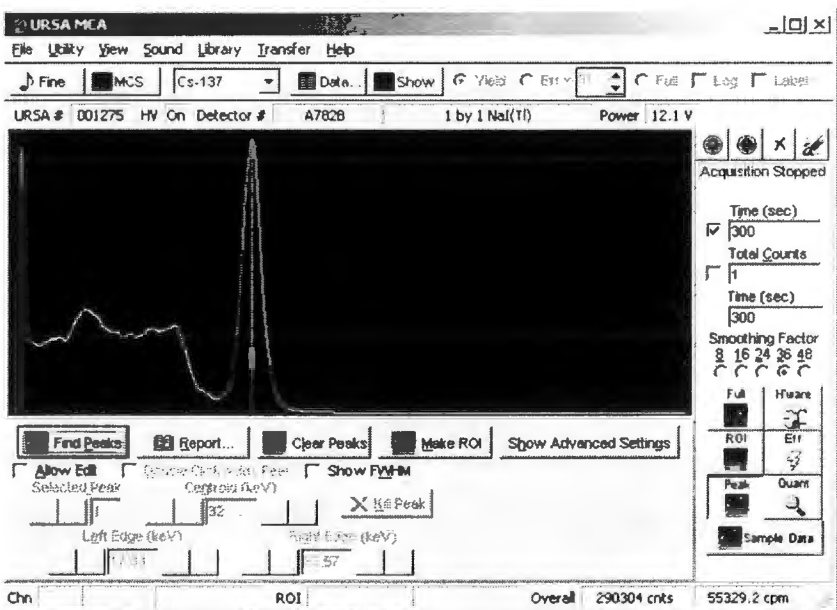
14. RCT Repeat steps 12 and 13 for each source included in this ROI.

Note: The number of sources should be minimized since the background is counted each time a source is counted and may interfere with the accuracy of the ROI.

Creating an ROI Using *Find Peak* (i.e., *Automatic Method*)

15. RCT Click on *Peak* on the URSA button panel. This will open the peak settings panel along the bottom of the spectrum display.

16. RCT



From the Peak Panel, click on *Find Peaks*. The peaks and their ROIs will be highlighted automatically in green.

17. The found peaks should now be edited, as needed, based on Section 1 of the URSA ROI Setup Datasheet (Exhibit 4), by clicking on the "Allow Edit" box. The user can now adjust the centroid and the left and right edges of each peak region. Peaks can also be added as well as deleted.

a) To add a peak, simply click on the *Double Click Adds Peak* box. Locate a peak on the spectrum with the mouse and double click. Another peak region will appear.

i. To adjust the centroid, left or right edges of any peak region:

ii. Select a peak using the *Selected Peak* arrow set. (Default designates the left-most peak #1.) The selected peak will appear in purple highlight, while the remaining peaks will be highlighted in green.

b) Using the *Centroid (keV)*, *Left Edge (keV)* and *Right Edge (keV)* arrow sets, adjust accordingly. (Double arrows adjust the settings in approximately 5 keV increments, while the single arrows adjust the settings in approximately 0.5 keV increments.)

i. To delete a peak, first select the peak to be deleted using the *Selected Peak* arrow set.

ii. Once the peak is highlighted, click on the *Kill Peak* button.

18	RCT	Report the Source SN#, Energy, and Channel for the selected ROI peaks established on the URSA ROI Setup Datasheet(s) (Exhibit 4).
19.	RCT	When finished editing found peaks, click on *Make ROI* on the Peak Panel to convert the found peaks into an ROI set. A message will display indicating that the ROI set should be given a name (see Exhibit 3). Naming the ROI set can be put off until later, but it is highly recommended that a name be given now.
20.	RCT	Type a name in the *Save ROI Set* dialog, and click the Save button. Remember to appropriately name the ROI set so you can distinguish which detector it is used with.
21.	RCT	Once the set has been saved, the panel along the bottom of the spectrum display will switch over to the ROI Panel to allow additional editing (as described in Step 17), if desired to establish consistency with Section 1 of the URSA ROI Setup Datasheet (Exhibit 4) and document any changes on this datasheet.
22.	RCT	Go to Step 30.
		Manually Creating or Editing an ROI Set (*Manual Method*)
23.	RCT	Click on *ROI* on the URSA button panel. This will open the ROI edit settings panel along the bottom of the spectrum display.
24.	RCT	To create a new ROI set, click on the *New ROI Set* button to assign a file name to the new set. (If this is not done before the following steps, a "Not Saved!" warning will be displayed as a reminder. This warning will also be shown any time the ROI as displayed is different from the saved ROI file.)

25. RCT To create an ROI by dragging on the spectrum display continue this step (otherwise go to the next step), as needed, based on Section 1 of the URSA ROI Setup Datasheet (Exhibit 4),:

a) Use the left and right arrow buttons to either select an existing ROI to edit (it will be displayed on the spectrum in fuchsia) or select a "blank" ROI (input fields will be blank and no fuchsia will be present on the spectrum display).

b) Click on the *Set ROI* radio button.

c) Use the cursor to locate the edge of the desired region. Click and drag the fuchsia box to encompasses the desired region

26. RCT To create an ROI by double clicking each edge continue this step (otherwise go to the next step), as needed, based on Section 1 of the URSA ROI Setup Datasheet (Exhibit 4),:

a) Use the left and right arrow buttons to either select an existing ROI to edit (it will be displayed on the spectrum in fuchsia) or select a "blank" ROI (input fields will be blank and no fuchsia will be present on the spectrum display).

b) To set the left edge, click on the *Double Click to set Starting Energy (keV)* radio button. To set the right edge, click on the "Double Click to set Ending Energy (keV)" radio button.

c) Position the cursor at the suitable location on the spectrum display and double click.

d) The energy and associated channel will be displayed in the appropriate boxes on the ROI Panel.

e) When both edges have been entered, the ROI will be displayed on the spectrum in fuchsia.

27. RCT To create an ROI by manually entering values continue this step (otherwise go to the next step), as needed, based on Section 1 of the URSA ROI Setup Datasheet (Exhibit 4),:

a) Use the left and right arrow buttons to either select an existing ROI to edit (it will be displayed on the spectrum in fuchsia) or select a "blank" ROI (input fields will be blank and no fuchsia will be present on the spectrum display).

b) To set the left edge, click on the "Starting Energy (keV)" input box.

c) To set the right edge, click on the "Ending Energy (keV)" input box.Enter the starting or ending energy for the ROI.

28. RCT ROIs can be edited, as needed, based on Section 1 of the URSA ROI Setup Datasheet (Exhibit 4), by using the relevant arrow and double arrow keys. Arrows move the edge of the ROI by one channel, double arrows move the ROI by ten channels.

29. RCT Type a name for the ROI in the "ROI Name" box (see Exhibit 3). While it is not strictly required that each ROI be given a name, it is strongly recommended. Individual ROI names can be up to 24 characters long.

Creating or Editing an ROI Set (General Actions)

30. RCT Record the expiration date of the ROI and then sign and date the datasheet.

31 RCT Repeat steps 1 to 30 as necessary to generate all the ROIs required.

32 RCT Implement Section 7.07 just prior to terminating the procedure for the shift or day.

33. PHP Review the ROI results and arranges for corrective actions as necessary or signs URSA ROI Setup Datasheet (Exhibit 4) authorizing the Setup for use.
34. PHP Arrange to update the Current URSA Detector Configuration Log (see Exhibit 3) in the SOP manual.

    Note: This update may be delayed as needed to minimize the costs and impact on the records and document control system.
35. HP Implements the data verification process addressed in Section 7.06.

    Note: Analyses based on this detector configuration should not be released to the customer as finalized data until the data verification process has been completed.

7.05 Quantification Calibration

Prerequiste: The Energy Calibration (see Section 7.03 except for Step 26) and appropriate ROIs loaded (see Section 7.04 Steps 34 and 35) before this section can be initiated.

The operation of the URSA uses a Windows™ based interactive computer screen; the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual.

Note: When using a 60 Hertz A.C. source the power source or having the detector cable near power for the URSA may generate low level peaks every 60 keV which may impact data quality. Thus the data should be reviewed for this impact and this impact should part of the system background. Ideally the 60 Hertz interference should be eliminated if practicable.

Note: The PHP must provide routine technical oversight/supervision of this task.

1. RCT If Section 7.02, 7.03, or 7.04 has just be complete and the system is already setup go to Step 12, otherwise obtain the required equipment, sources, and datasheets per direction of the PHP.
2. RCT Complete the balance of the initial section of the URSA Efficiency Calibration Datasheet(s) (Exhibit 5) and enter the datasheet number.
3. RCT Set up system at a location convenient for analysis, that minimizes background impacts.
4. RCT Start the computer.
5. RCT Select a detector/geometry. If the designated detector/geometry is not available or the Setup or Calibration has expired, consult PHP to arrange for the addition of detector or recalibration per Sections 7.01, 7.02, 7.03, or 7.04; URSA Setup or, if qualified, implement this procedure to add detector.
6. RCT Enable *High Voltage* and verify that the *High Voltage, Gain*, and *Threshold* are consistent with the data in the URSA Efficiency Calibration Datasheet(s) (Exhibit 5)or the Current URSA Detector Configuration Log, If inconsistent contact the PHP for direction and note this in the comment section of the datasheet.
7. RCT If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery need to be replaced immediately) shut down URSA & computer, then sign

and date the datasheet and store datasheet in accordance with applicable procedures and Project Management direction, and then terminate this procedure.

8. RCT Record the data in Section 2 including the *High Voltage, Gain*, *Fine Gain*, and *Threshold* on the URSA ROI Setup Datasheet(s) (Exhibit 4).
9. RCT Check the *Time* block then enter the background count time and the smoothing factor (see Section 7.02, Step 5) specified by the PHP.
10. RCT Ensure the source are secure away from the detector then click the *Start* button to begin data acquisition.
11. RCT Once acquisition is complete, then click on the *File* button and save the file as a background spectrum. File naming is typically the Datasheet Number followed by a unique number then LB for location backgrounds.
12. RCT Complete the portions of Section 1 and 2 requiring additional information, consult the PHP as needed for information.
13. RCT Check the *Time* or *Total Counts* line (as appropriate) and enter the value specified on the datasheet
14. RCT Click the *File* and then the *Load Spectrum as Background* buttons and select the current background file.

    Note: If none available acquire a background spectra prior to proceeding, if practicable.
15. RCT Position the designated source in the detector configuration and then click the *Start* button to begin data acquisition
16. RCT Click on "*Eff*" on the URSA button panel. This will open the efficiency calibration panel along the bottom of the spectrum display.
17. RCT To calibrate, click on the "*Allow Edi*t" box.
18. RCT Select a specific ROI [see URSA ROI Setup Datasheet(s) (Exhibit 4)] using the "*ROI #*" arrows.
19. RCT If the ROI is one contained in the calibration source:
    a) Select the nuclide for the ROI from the "*Associated Nuclide*" drop-down list.
    b) Select the peak energy for the ROI from the "*Associated Peak*" drop-down list.
    c) Enter the activity of the source being used in the "*Activity*" box
    d) Select the appropriate units from the "*Units*" drop-down list.

    NOTE: The units must be the same for all isotope activities entered for the calibration!
20. RCT If the ROI is *not* contained in the calibration source :
    a) Check the "*Assign ROI as Unknown*" box.
    b) Select the nuclide for the ROI from the "*Associated Nuclide*" drop-down list.
    c) Select the peak energy for the ROI from the "*Associated Peak*" drop-down list.
21. RCT Click on the "*ROI Eff. Cal!*" button.
22. RCT Click on the "*Report*" button to view, save, or print (if printer is available print and attach to datasheet, if not save the report) the efficiency calibration report. This report is available any time following the efficiency calibration, until replaced by a new efficiency calibration.
23. RCT Record the expiration date of the ROI and then sign and date the datasheet.

Note: Expiration date can't be after the expiration date of applicable ROI.

24. RCT Check the ROI efficiency calibrations completed, address uncompleted items in comment section.
25. RCT Repeat steps 1 to 24 as necessary to generate efficiency calibrations for the designated ROIs.
26. RCT Implement Section 7.07 just prior to terminating the procedure for the shift or day.
27. RCT Provides copy of datasheets to PHP and requests that the PHP sign the original datasheets.
27. PHP Review the ROI results and arranges for corrective actions as necessary or signs URSA ROI Setup Datasheet (Exhibit 4) authorizing the Setup for use.
28. PHP Arrange to update the Current URSA Detector Configuration Log (see Exhibit 3) in the SOP manual.

    Note: This update may be delayed as needed to minimize the costs and impact on the records and document control system.

29. HP Implements the data verification process addressed in Section 7.06.

    Note: Analyses based on this detector configuration should not be released to the customer as finalized data until the data verification process has been completed.

7.06 Data Verification

Note: This is the initial step in the verification and validation of the data generated by the URSA for various samples and locations. The analysis process (e.g., Guidance for Spectrum Analysis Process, Section 8.1) will address the balance of the data verification and validation process.

1. HP On the routine basis established in the work plan or if no basis is specified at least every 20 working days, obtain the datasheets (i.e., Exhibits 1, 2, 4,5, and/or 6) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).
2. HP Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.
3. HP Review the data for the following technical considerations:

    - Are the data technical consistent,
    - Were appropriate and current calibration sources used,
    - Is there appropriate documentation for all calibrations sources in the records,
    - Were appropriate peaks selected for radionuclide/isotope identification and quantification of activity,
    - Are the background values credible and are the background data consistent with the statistical variability expected,
    - Are the expected progeny present and in the appropriate ratios,
    - Are the expected background radionuclides present,
    - Are there any radionuclides identified or present in concentrations that are not credible or at least require followup,
    - Have appropriate backgrounds data set been obtained,

- Is there consistency between these values and the other survey data,
- Are the radionuclides present in credible relative ratios,
- Is additional count time required to resolve spectra appropriately,
- Are there unidentified peaks that require resolution,
- Are there potential mis-identified peaks (e.g, impact of interferences),
- Does the equipment appear to be functioning properly,
- Were any technical concerns/inconsistencies appropriately followed up on and resolved,
- Has the appropriate quality control/verification samples been taken,
- Are there any other outstanding technical, operational, or quality issues associated with the data.

4. HP If there are problems or potential problems associated the data, the HP initiates the Guidance for Spectrum Analysis Process, Section 8.2 (Woolfolk, 2000), other SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.
5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.
6. HP Documents the nonconformance report (NCR) number(s) [i.e., notes in the Data Verified line indicating that the data is verified with closure of NCR #(s)] associated with this verification and signs and dates the data sheets as verified (i.e., verified pending resolution of outstanding NCRs) and stores the documentation in accordance with applicable procedures and Project Management direction, then complete Section 7.07 and terminate this procedure

7.07 Calibration Record Submission

1. RCT Review the datasheet package collected during this activity and identify any reports, plateau graphics, or spectrum graphics that were not printed and associated file names.
2. RCT Start computer and initiate URSA software (if the URSA is not still attached to computer it will be necessary to use the off-line version of the software).
3. RCT If additional printouts are required, click on *File* and select *Load Spectrum to Live* and load the file; otherwise go to step 6.
4. RCT Click on *Print Spectrum* and add printout to appropriate datasheet(s).
5. RCT Click on *Report* (e.g., see Exhibit 7) and select *Print* and add printout to appropriate datasheet.
6. RCT Repeat steps 3 and 5 until all printouts available are obtained.
7. RCT Transfer copies of all data files to backup files (preferably duplicate).
8. RCT Attach spectra and other printouts to the back of the datasheet(s).
9. RCT Store the documentation and files in accordance with applicable procedures and Project Management direction, and terminate this activity.

8.0 RECORDS

The following records:

- URSA Detector Setup Datasheet(s) (Exhibit 1),
- URSA Detector Energy Calibration Datasheet(s) (Exhibit 2),
- URSA ROI Datasheet(s) (Exhibit 4),
- URSA Efficiency Calibration Datasheet(s) (Exhibit 5),
- URSA Detector Setup & Calibration Datasheet(s) (Exhibit 6),
- attachments to the datasheets (e.g., spectra, Exhibit 7), and
- any applicable associated NCRs

are the quality records generated by this procedure.

Exhibit 3 is an informational listing maintained in the instrumentation data section at the back of the SOP manual. These are not quality records and are there only for convenience. These listings (i.e., Exhibit 3) in the SOP manual are only there to assist the user in locating the required information in the computer.

Exhibit 1

PARSONS	URSA DETECTOR SETUP DATASHEET	SOP-R-MCA-1-1 -______ Revision 0

Section 1

Project:				No.	
Initiated by (print):				Date:	
Detector Type				Detector SN	
Detector Description					(/ /)
URSA SN		Computer SN		Smoothing Factor	
Location				Detector cable length (inches)	

Setup Source(s)	S/N #	Radionuclide(s)	Peaks	Describe Geometry		
				Temp (°C)		Thermo. #.

ProjectedOperating Voltage (volts)		Maximum Voltage (volts)	

Section 2

Confirm & Record URSA Detector Designation (see data above)				High Voltage Enabled		Yes		No	
Check Source(s) (S/N & Activity)		(dpm)				(dpm)			
		(dpm)				(dpm)			
Power (volts)		Power Source	DC		AC		Battery Replaced?	Ye s	No

HardWare Settings

High Voltage (volts)		Gain	
Threshold		Fine Tuning	

Check/Tuning Source Results End-of-Shift-Tuning (Optional)						Count time (sec)		
Peak's Energy (kev)								
Count								

Comments:

Completed by (signature)		Date	

Authorized For Use

PHP (Print)		PHP Signature		Date:	

Data Verified

HP (Print)		HP Signature		Date:	

Exhibit 2

PARSONS	URSA Detector Energy Calibration Datasheet	SOP-R-MCA-1-2 -________ Revision 0

Section 1

Project:				No.		
Initiated by (print):				Date:		
Detector Type			Detector Model			
Detector SN			Manufacturer			
Detector Description	(/ /)					
URSA SN		Computer SN		Smoothing Factor		
Location		Expiration Date for Calibration		Detector to URSA Cable Length (inches)		
Related URSA Detector Setup Datasheet Number	SOP-R-MCA-1-1-________	Count Time (min.)	Background	Calibration		

Calibration Source(s)	S/N #	Radionuclide(s)	Energy Peak To Be Used (KeV)

Section 2

Confirm & Record URSA Detector Designation (see data above)				High Voltage (volts)				
Threshold		Gain		Fine Gain				
Power (volts)		Power Source	DC		AC		Battery Replaced?	Yes		No	

Calibration Data

Source (S/N#)	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel
						Calibration Expires		

Comments:

Completed by (signature)		Date	

Authorized For Use

PHP (Print)		PHP Signature		Date:	

Data Verified

HP (Print)		HP Signature		Date:	

Exhibit 3

Table of Detector Configurations

PARSONS	Current URSA Detector Configuration Log		SOP-R-MCA-2-2 -________ Revision 0
URSA S/N:		Sheet:	of
Detector Geometry Configuration			
No.	Description (i.e., Detector and Geometry Description.		Expiration Date

Note: The Detector Configuration Number is:

- Detector Model Designator-Detector S/N#-Source Type Designator-Expiration Date (YYMMDD format)-Sequence Number or other unique identifier (e.g., FID-34556-V-011231-1). Where:

Designator Key		
Designator	Item	Type
FID	Fidler	Detector
NAI2X2	2 X 2 NaI	Detector
NAI1X1	1 X 1 NaI	Detector
ANT	Anthracene Solid State	Detector
P	Point	Source
S	Surface	Source
V	Volume	Source
Designator may be added by PHP as necessary using a similar format without revision of this procedure.		

Table of ROIs

PARSONS	Current URSA ROI Log		SOP-R-MCA-2-3 -________ Revision 0
URSA S/N:		Sheet:	of
ROI Description			
No.	Description (i.e., Radionuclides and energy range in KEV)	Fine Tuning Source Number	Expiration Date

Note: The ROI number is:

- Atomic number (i.e., include preceding zeros for 3 digits, e.g., for hydrogen 001) of the radionuclides in order (for up to the first 3 radionuclides), a dash, then the expiration date (YYMMDD format), a dash, a sequence number or other unique identifier. (e.g., 055092-011231-1 for a Cs and U ROI). When it is operationally helpful the unique identifier could be the last number of the atomic weight of one of the radionuclides.

Exhibit 4

PARSONS	URSA ROI Setup Datasheet	SOP-R-MCA-1-3-____ Revision 0

Section 1

Project:		No.	
Initiated by (print):		Date:	
Detector Type		Detector Model	
Detector SN		Manufacturer	
Detector Description	(/ /)		

URSA SN		Computer SN		Smoothing Factor	
Location		Expiration Date for ROI		Detector to URSA Cable Length (inches)	

URSA Detector Energy Calibration Datasheet Number	SOP-R-MCA-1-2-____	Count Time (min.)	Background (optional)	Calibration

ROI Setup Source(s)	S/N #	Radionuclide(s)	Energy Peak To Be Used (KeV)

Section 2

Confirm & Record URSA Detector Designation (see data above)		High Voltage (volts)	
Threshold		Gain		Fine Gain	

Power (volts)		Power Source	DC		AC		Battery Replaced?	Yes		No	

Calibration Data

Source (S/N#)	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel
						ROI Expires		

Comments:

Completed by (signature)		Date	

Authorized For Use

PHP (Print)		PHP Signature		Date:	

Data Verified

HP (Print)		HP Signature		Date:	

Exhibit 5

PARSONS	URSA Efficiency Calibration Datasheet	SOP-R-MCA-1-4-______ Revision 0

Section 1

Project:		No.	
Initiated by (print):		Date:	
Detector Type		Detector Model	
Detector SN		Manufacturer	
Detector Description	(/ /)		

URSA SN		Computer SN		Smoothing Factor	
Location		Activity Units		Detector to URSA Cable Length (inches)	

URSA ROI Setup Datasheet Number	SOP-R-MCA-1-3-______	Count Time (min.)	Background (optional)	Calibration

ROI	Source S/N #	Radionuclide(s)	Energy Peak To Be Used (KeV)	ROI Exp	Activity	Completed	Eff. Cal. Exp.

Section 2

Confirm & Record URSA Detector Designation (see data above)					High Voltage (volts)						
Threshold		Gain			Fine Gain						
Power (volts)		Power Source	DC		AC		Battery Replaced?	Yes		No	

Comments:

Completed by (signature)		Date	

Authorized For Use

PHP (Print)		PHP Signature		Date:	

Data Verified

HP (Print)		HP Signature		Date:	

Exhibit 6

PARSONS	URSA DETECTOR SETUP & CALIBRATION DATASHEET	SOP-R-MCA-1-5 -________ Revision 0

Section 1				Sheet 1 of 3
Project:			No.	
Initiated by (print):			Date:	
Detector Type		Detector Model		
Detector SN		Manufacturer		
Detector Description	(/ /)			
URSA SN		Computer SN		Smoothing Factor	
Location		Detector to URSA cable length (inches)		
Calibration Source(s)	S/N #	Radionuclide(s)	Describe Geometry	
ProjectedOperating Voltage (volts)		Maximum Voltage (volts)		

Section 2										
Confirm & Record URSA Detector Designation (see data above)			High Voltage Enabled				Yes		No	
Check Source(s) (S/N & Activity)		(dpm)					(dpm)			
		(dpm)					(dpm)			
Power (volts)		Power Source	DC		AC		Battery Replaced?	Yes		No

HardWare Settings			
High Voltage (volts)		Gain	
Threshold		Fine Tuning	

Check/Tuning Source Results End-of-Shift-Tuning (Optional)					Count time (sec)		
Peak's Energy (kev)							
Count							
Completed by (signature)					Date		

Energy Calibration					
Energy Calibration Section 1					
Detector Description	(/ /)				
Location	Expiration Date for Calibration		Detector to URSA Cable Length (inches)		
		Count Time (min.)		Background	Calibration

EXHIBIT 6 (continued)

PARSONS	URSA Detector Energy Calibration Datasheet	SOP-R-MCA-1-5 -________ Revision 0

Energy Calibration Section 1			Sheet 2 of 3
Calibration Source(s)	S/N #	Radionuclide(s)	Energy Peak To Be Used (KeV)

Energy Calibration Section 2									
Confirm & Record URSA Detector Designation (see data above)				High Voltage (volts)					
Threshold		Gain		Fine Gain					
Power (volts)		Power Source	DC		AC		Battery Replaced?	Yes		No	

Energy Calibration Data								
Source (S/N#)	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel
						Calibration Expires		

Completed by (signature)		Date	

ROI Setup

ROI Setup Section 1					
Expiration Date for ROI		Count Time (min.)		Background (optional)	Calibration

ROI Setup Source(s)	S/N #	Radionuclide(s)	Energy Peak To Be Used (KeV)

ROI Setup Section 2

Confirm & Record URSA Detector Designation (see data above)				High Voltage (volts)			
Threshold		Gain				Fine Gain	
Power (volts)		Power Source	DC		AC		Battery Replaced?	

EXHIBIT 6 (continued)

PARSONS	URSA Detector Setup & Calibration Datasheet	SOP-R-MCA-1-5 -__________ Revision 0

ROI Data								Sheet 3 of 3
Source (S/N#)	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel	Source	Energy Peak (keV)	Channel
						ROI Expires		

Completed by (signature)		Date	

Efficiency Calibration

Efficiency Calibration Section 1

Location		Activity Units		Detector to URSA Cable Length (inches)	

URSA ROI Setup Datasheet Number	SOP-R-MCA-1-3-__________	Count Time (min.)	Background (optional)	Calibration

ROI	Source S/N #	Radionuclide(s)	Energy Peak To Be Used (KeV)	ROI Exp	Activity	Completed	Eff. Cal. Exp.

Comments:

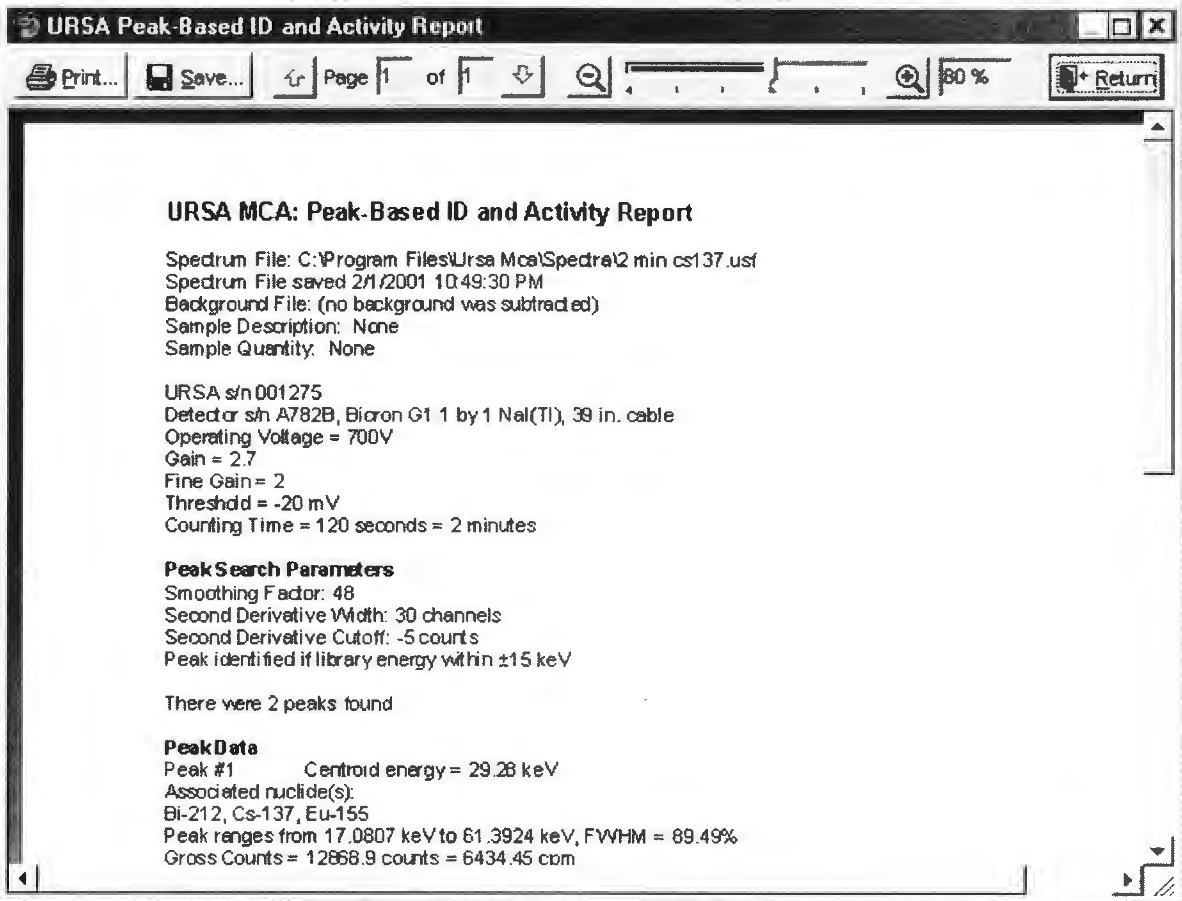
Completed by (signature)		Date	

Authorized For Use					
PHP (Print)		PHP Signature		Date:	

Data Verified					
HP (Print)		HP Signature		Date:	

Exhibit 7

URSA MCA: Peak-Based ID and Activity Report



URSA MCA: Peak-Based ID and Activity Report

Spectrum File: C:\Program Files\Ursa Mca\Spectra\2 min cs137.usf
Spectrum File saved 2/1/2001 10:49:30 PM
Background File: (no background was subtracted)
Sample Description: None
Sample Quantity: None

URSA s/n 001275
Detector s/n A782B, Bicron G1 1 by 1 NaI(Tl), 39 in. cable
Operating Voltage = 700V
Gain = 2.7
Fine Gain = 2
Threshold = -20 mV
Counting Time = 120 seconds = 2 minutes

Peak Search Parameters
Smoothing Factor: 48
Second Derivative Width: 30 channels
Second Derivative Cutoff: -5 counts
Peak identified if library energy within ±15 keV

There were 2 peaks found

Peak Data
Peak #1 Centroid energy = 29.28 keV
Associated nuclide(s):
Bi-212, Cs-137, Eu-155
Peak ranges from 17.0807 keV to 61.3924 keV, FWHM = 89.49%
Gross Counts = 12868.9 counts = 6434.45 cpm

1.0 PURPOSE

This procedure provides the requirements for identifying gamma emitting radionuclides and surface activities using the Universal Radiation Spectrum Analyzer (URSA) with various detectors. The purpose of this procedure is to institute URSA Daily operational checks and to standardize the operation of this instrument and documentation of the data to ensure that quality field measurements are obtained.

2.0 SCOPE

- This procedure is applicable to the measurement of radioactivity and the identification of radionuclides in samples and insitu using the URSA and associated detector, authorized by the professional health physicist responsible for the activity. This procedure can only be implemented by trained and qualified personnel.

3.0 REFERENCES

1. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Final, December 1997.

2. *URSA Universal Radiation Spectrum Analyzer Operations Manual*, Radiation Safety Associates, Inc. 19 Pendleton Drive, PO Box 107 • Hebron, CT, 2001.

3. Knoll, Glenn F., 1989. Radiation Detection and Measurement, John Wiley & Sons, New York, New York, 1989 (ISBN 0-471-81504-7).

4. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

5. SOP-R-MCA-01, *Calibration of URSA MCA Systems,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

6. SOP-R-SUR-001, *GM Pancake Probe Surveys and Static Counts for Beta and Photon Activity for Environmental Investigations and Personnel Protection,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

7. Woolfolk, Steven and Ron McConn, 2001. *Guidance for Spectrum Analysis Process*, Parson Infrastructure and Technology Group, Inc., Richland, Washington, current version.

4.0 DEFINITIONS

1. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.

   The materials associated with the radiation source and any associate container including back-scatter surfaces.

2. **Mutichannel Analyzer (MCA)** is an instrument with the capability of collection of radiation flux data as a function of radiation energy when attached to a suitable detector. These instruments typically have associate hardware/software for the identification of radionuclides in addition to the assessment of detected flux.

3. **Photomultipler (PM) tube** receives light pulses from a detector and produces a current pulse proportional to the energy of the photons received by the tube and this pulse this can then be sorted and counted by equipment such as an MCA. The solid state equivalent is the photodiode.

4. **Region of interest (ROI)** is a set of spectral data peak typically associated with a radionuclide. This set of peaks is used when quantifying activity.

5. **Resolution** is a measure of the ability of the detector, photomultipler tube, and MCA system to include a discrete energy count in the appropriate MCA channel. In other words how uncertain (i.e., wide) the energy peak is. The resolution is the full width at half maximum of the full energy peak (FWHM) divided by the height of the energy peak (see Knoll, 1989).

6. **Scanning** is measurement of activity in count rate (e.g., cpm) by passing a detector over an area in a defined geometry and a set rate so that the area passes beneath the probe. The result of the scanning is the highest count rate for the area and possibly the average or range of variability of the count rate in the area. The URSA in *Multi Channel Scaling* mode

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

5.01 The MCA and detector must be current with respect to energy calibration to be used in the identification for radionuclides potentially present in the sample or material and must be of the type and model designated in the geometry specified in the URSA calibration files used.

5.02 The MCA and detector must be current with respect to efficiency calibration to be used to assess activity and the geometry, types, models, and serial numbers designated in the URSA efficiency calibration files used.

5.03 The MCA and detector must be set up as described in the associated URSA calibration files used.

5.04 Only qualified and trained personnel are allowed to operate the instrument.

5.05 An instrument background determination and instrument operational check in accordance with this procedure shall be performed prior to the first use of the instrument on each shift.

5.06 The instrument shall be fully functional prior to it use, or special authorization is required by the Project Health Physicist.

5.07 **NEVER ADJUST THE CALIBRATION CONTROLS** (i.e., High Voltage (HV), threshold, and gain) when implementing this procedure.

5.08 The detector type, settings, serial number, cord length and the geometry listed in the URSA calibration files must be conformed otherwise recalibration is required. detector are calibrated as a unit and may not be interchanged without recalibration.

6.0 RESPONSIBILITIES

6.01 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the instruments are properly maintained and calibrated at required intervals.

2. Training the Radiological Control Technicians (RCTs) in the proper use of this instrument.

3. Providing independent review of the instrument field test, operational checks, and measurement data to ensure that the data is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

4. Verifying calibration data at the time of collection or at least prior to use of the equipment.

5. Designating the appropriate detectors, sources, geometry, and background locations/materials to support the purposes of the survey.

6.02 Radiological Control Technicians (RCT) are responsible for:

1. Operating this instrument in accordance with this procedure and the applicable training.

2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

3. Maintaining URSA Daily operational check records for each instrument.

4. Documenting data collected using the instrument in accordance with appropriate regulations and procedures.

5. Reporting instrument malfunctions or out of specification conditions to the Project Health Physicist and/or Field Supervisor.

6. The PHP and professional health physicists who have meet the training and qualification requirements established for this procedure may complete tasks designated for the RCT.

6.03 Professional Health Physicist (not the Project Health Physicist) (HP)

1. Provide independent technical review of collect data and associated activities.

6.04 Project Manager (or designee, such as the field supervisor) (PM)

1. Provides required materials and trained/qualified personnel for implementation of the task.

2. Provides operational review of the project specific activities for these data collection activities.

7.0 PROCEDURES

Note: This procedure is for using the URSA MCA as a spectrometer with various detectors.

Note: The information in Exhibit 1 and 3 is an example, this information is controlled in SOP-R-MCA-001.

7.01 Operational Verification

Note: The operation of the URSA is based on a Windows based interactive computer screens, the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual.

Note: When using a 60 cycle A.C. source the power source may generate low level peaks every 60 cycles which may impact data quality. Thus the data should be reviewed for this impact and this impact should part of the system background.

1. PHP Review the work plan, site data, Guidance for Spectrum Analysis Process, URSA manual, applicable procedures, available detectors, and the URSA calibration data to determine:

- What *Pre-tuning* and *End-of-Shift-Tuning* peak data should be collected and recorded.
- Count (i.e., Acquisition) times for collection of *Tuning* data peaks, URSA Daily Background data peaks, and Sample/Location data. In some circumstances the total counts rather than the count time may be used to control the automatic counting period.
- Applicable source(s) for use in *Tuning* and performance checks addressed in this procedure.
- Equipment configuration (i.e., detector, URSA, cable, and computer).
- Applicable detector, system, geometry and associated ROIs.
- Locations for collection of background data and applicable background files to be used.
- Applicable smoothing factor.
- Applicable peaks for tuning and control charting (2 & verifications).
- Determination if quantification of activity is required and feasible.
- Arranging for completion of the appropriate energy and efficiency (i.e., quantification) calibrations and identifying these complete files to the RCT.

2. PHP Provide the RCT with the data identified in step 1.

3. RCT Obtain the required equipment, sources, and datasheets per direction of the PHP and PM and record URSA Detector Designation and the source(s) serial number and activity.

4. RCT Complete the initial section of the URSA Daily Operational Check Log and Collection Documentation (Exhibit 1) and enter the datasheet number.

5. RCT Complete initial section of the URSA Daily Operational Check Log and Collection Documentation. Consult your supervisor or the PHP, as need, for support in completing this data.

6. RCT Assemble URSA system (i.e., detector, MCA, and computer). Ensure that the computer is attached on COM1 or COM2.

7. RCT Start the computer.

8. RCT Select a detector/geometry. If designated detector/geometry is not available, consult PHP to arrange for the addition of detector per SOP-R-MCA-1, URSA Setup and Calibration or, if qualified, implement this procedure to add detector.

   Note: Exhibit 3 contains a sample of the URSA configuration log that is maintained at the back of the SOP manual for designation of detector/geometry configuration by the PHP.

9. RCT Enable high voltage and document steps 8 an d 9 on the URSA Daily Operational Check Log and Collection Documentation (Exhibit 1)

10. RCT Select the appropriate ROI. If the designated ROI is not available, consult PHP to arrange for the addition of ROI per SOP-R-MCA-1, URSA Setup and Calibration or, if qualified, implement this procedure to add detector.

    Note: Exhibit 3 contains a sample of the URSA configuration log that is maintained at the back of the SOP manual for designation of ROIs by the PHP.

11. RCT Record the power voltage and verify that this voltage is at least 10 volts.

    Note: Below 10 volts URSA will provide a low power warning. If the voltage is low it may be appropriate to replace the batteries and restart this procedure at Step 7.

12. RCT Indicate if batteries have been replaced on the datasheet. If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery need to be replaced immediately) shut down URSA & computer and replace the batteries, then restart this procedure at Step 7.

13. RCT Configure the designated fine tuning source and the detector consistent with the detector system and ROI. (see Exhibit 3)

14. RCT If the Project Manager or PHP requires a *Pre-tuning* peak dataset, enter the designated count time (established by the PHP) on the datasheet.

15. RCT Check the time block and enter the *Tuning* time in seconds in the *Time* block on the URSA input screen and enter the Smoothing Factor.

16. RCT Click the *Start* button to begin data acquisition.

17. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

18. RCT Record the channels of the designated peak *Pre-Tuning* data on the datasheet.

19. RCT Click on the *Fine Tune* button on the button bar. A small window will pop up and display an isotope selection drop-down menu and an energy peak selection drop-down menu. The hardware settings panel will also open along the bottom of the spectrum display, but only the "Fine Gain Adjust (±64)" will be active.

20. RCT Select an isotope and an energy peak from the drop-down menus.

21. RCT Click on the *Fine Tun*e button.

Note: The corresponding isotope source must be appropriately position relative to the detector in order for the fine tuning to be successful.

22. RCT A series of acquisitions will follow until the most accurate fine gain adjustment is achieved. This could take several minutes. A "Fine Gain Adjustment Complete" message will appear when the procedure is done, if not consult PHP to arrange recalibration of this configuration per SOP-R-MCA-1, URSA Setup and Calibration or, if qualified, you may implement this procedure. Indicate *yes* if the fine tuning was successfully completed, otherwise check *no* and terminate this procedure after signing and dating the datasheet, unless you receive specific direction from the PHP.

23. RCT Once the *fine tuning* is complete, check the time block and enter the *Tuning* time in seconds in the Time block, if not already entered.

24. RCT Click the *Start* button to begin data acquisition.

25. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

26. RCT Record the designated peak *Post-Tuning* data on the datasheet.

27. RCT Check the time block and enter the *Tuning* time in seconds in the *Time* block, if not already entered, as necessary to set to the background count time.

28. RCT After the source has been removed from the area, click the *Start* button to begin data acquisition.

NOTE: The collection of this background data should use the same type of power source since the power source is one of the sources of background variability.

29. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

30. RCT Record the designated peak "Background" data on the datasheet.

31. RCT Enter the *Post-Tuning* and *Background* data into the control chart and determine if the results are outside of the 2 σ uncertainty band on the control chart.

32. RCT If either is outside the applicable band, obtain the PHP authorization before preceding or terminate this procedure after signing and dating the data sheet.

33. RCT Indicated if quantification is required on the datasheet and, if required, record the calibration date on the datasheet (Exhibit 1).

34. RCT If the PHP has determined that a *End-of-Shift Tuning* result is not require; sign and date this datasheet and store in accordance with applicable procedures and Project Management direction.

35. RCT Proceed to Section 7.02 to collect data.

7.02 Data Collection

The operation of the URSA is based on Windows based interactive computer screens, the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual. Section 7.04 contains steps that are integrated into this process if an existing spectrum collection activity is to be restarted.

Note: When using a 60 cycle A.C. source the power source may generate low level peaks every 60 cycles which may impact data quality. Thus the resulting data should be reviewed for this impact and the impact should be part of the background data..

1. PHP Review the work plan, site data, Guidance for Spectrum Analysis Process, URSA manual, applicable procedures, available detectors, and the URSA calibration data to determine:
- Determination of the frequency at which "Tuning" peak data is should be collected and recorded.
- Count (i.e., Acquisition) times for collection of location background, material backgrounds, and sample/location data, as applicable.
- Applicable location and/or material backgrounds to be applied to the data collection.
- Equipment configuration (i.e.. detector, URSA, cable, and computer).
- Applicable geometry and associated ROIs.
- Applicable URSA Daily Operational Checklog and Collection Documentation.

2. PHP Provides the RCT with the data identified in Step 1.

3. RCT Obtain the required equipment, sources, and datasheets per direction of the PHP and PM consistent with the referenced URSA Daily Operational Check Log and Collection Documentation (Exhibit 1).

4. RCT Complete the initial section of the Data Collection Datasheet(Exhibit 4) and enter the datasheet number.

Note: Continuation of this datasheet can be made as needed using Exhibit 4. When using the continuation sheet record the sheet number and the datasheet number, based on the previous page(s).

5. RCT Set up system at the location to be analyzed or at a location convenient for analysis of the samples, that minimizes background impacts.

6. RCT Record the following information for the data collection activity:

- Location/sample number.
- Location/sample description.
- Whether the data being collected is a location background, material background, sample data, or location data.
- The count (acquisition time) or if a specific total counts have been specified enter the value and the *counts*.
- If the PHP designated that intermittent fine tuning was required the fine tuning data number (see bottom of the datasheet) that proceed the data collection, if any.
- Applicable location background file, if any.
- Applicable material background file, if any.

7. RCT Start the computer, turn on URSA, and start software once Windows has booted up.

8. RCT Select a detector/geometry. If the designated detector/geometry is not available, consult PHP to arrange for the addition of detector per SOP-R-MCA-1, URSA Setup and Calibration or, if qualified, implement this procedure to add detector.

Note: Exhibit 3 contains a sample of the URSA configuration log that is maintained at the back of the SOP manual for designation of detector/geometry configuration by the PHP.

9. RCT Enable high voltage and verify it is consistent with the URSA Daily Operational Check Log and Collection Documentation (Exhibit 1)

10. RCT If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery need to be replaced immediately) shut down URSA & computer, then sign and date the datasheet and store datasheet in accordance with applicable procedures and Project Management direction.

11. RCT If the PHP specified a count time, check the time block and enter the count Acquisition time in seconds in the Time block on the URSA input screen. Otherwise check the Total Count block and enter the total number of counts specified.

12. RCT If this is a restart of a previous count complete Section 7.04, otherwise click the *Start* button to begin data acquisition.

13. RCT Once acquisition is complete, click on the *File* button and save the file as a spectrum. File naming is typically the Datasheet Number followed by the dataset number. For background files the letter LB or MB are added to the location and material backgrounds, respectively. If the file has been collected before add an R and the revision number to the file.

14. RCT If *Tuning* is required after this collection, configure the designated fine tuning source, and the detector consistent with the ROI.and geometry data (see Exhibit 3)

15. RCT Click the *Start* button to begin data acquisition.

16. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

17. RCT Record the designated peak Before section of the first available *Tuning* data line on the bottom of the datasheet (see Exhibit 4).

18. RCT Click on the *Fine* button on the button bar. A small window will pop up and display an isotope selection drop-down menu and an energy peak selection drop-down menu. The hardware settings panel will also open along the bottom of the spectrum display, but only the "Fine Gain Adjust (±64)" will be active.

19. RCT Select an isotope and an energy peak from the drop-down menus.

20. RCT Click on the Fine Tune button.

Note: The corresponding isotope source must be positioned consistent with ROI and geometry relative to the detector in order for the fine tuning to be successful.

21. RCT A series of acquisitions will follow until the most accurate fine gain adjustment is achieved. This could take several minutes. A "Fine Gain Adjustment Complete" message will appear when the procedure is done, if not consult PHP to arrange recalibration of this configuration or . per SOP-R-MCA-1, URSA Setup and Calibration or if qualified implement this procedure. Sign and date the data collection datasheet and store in accordance with applicable procedures and Project Management direction, then terminate the procedure

22. RCT Click the *Start* button to begin data acquisition.

23. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

24. RCT Record the designated peak After section of the first available *Tuning* data line on the bottom of the datasheet (see Exhibit 4).

25. RCT If additional data is to be taken check the time block and enter the count time in seconds in the *Time* block (or the equivalent count data), if not already entered, as necessary to set then go to Step 5.

26. RCT Number sheets, record total sheet count, sign and date the URSA Data Collection Documentation (see Exhibit 4). Store the documentation in accordance with applicable procedures and Project Management direction, then go to Section 7.07 of this procedure, unless "End-of-Shift" activities are required then go to Section 7.03.

7.03 End-of-Shift Activities (if required)

1. RCT If the PHP requires an *End-of-Shift tuning* data, configure the designated fine tuning source and the detector consistent with the ROI. (see Exhibit 3)

2. RCT Enter the designated count time (established by the PHP) on the URSA Daily Operational Checklog and Collection Documentation (Exhibit 1)and in check time and enter the count time on the URSA input screen, if not already correct.

3. RCT Click the *Start* button to begin data acquisition.

4. RCT Once the acquisition is complete, use the cursor to obtain the designated peak count rates based on the current energy calibration.

5. RCT Record the designated peak *End-of-Shift* data on the datasheet.

6. RCT Sign and date the URSA Daily Operational Checklog and Collection Documentation (Exhibit 1) and store the documentation in accordance with applicable procedures and Project Management direction and terminate this activity, then go to Section 7.07.

7.04 Spectra Collection Restart

This section maybe repeated as needed to address all spectra requiring additional data.

1. PHP Identifies spectra requiring additional data and identifies the data file and collection location to the RCT.
2. RCT Initiates URSA Daily operation as specified in Section 7.01 and 7.02 Steps 7.021 to 7.0212.
3. RCT Click the *File* button and select *Load Spectrum to Live* and load the designated file.
4. RCT If the PHP specified additional count time, check the count *time* box and set the *Time* or *Count* the value specified.
5. RCT If the PHP specified a total count to be reached, check the *Total Count* box and set to the total count.
6. RCT Verify that the configuration of equipment and settings are consistent with the loaded file. If not contact PHP for specific direction.
7. RCT Press *Start* button to restart data acquisition.
8. RCT Return to Section 7.02, Step 7.0214.

7.05 Use of URSA In Gross Count Mode For Surveys

Note: The operation of the URSA is based on Windows based interactive computer screens, the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual. Section 7.04 contains steps that are integrated into this process if an existing spectrum collection activity is to be restarted.

Note: When using a 60 cycle A.C. source the power source may generate low level peaks every 60 cycles which may impact data quality. Thus the resulting data should be reviewed for this impact and the impact should be part of the background data.

Note: This instrument will be used to determine if radiological contamination (photon-emitting radioisotopes) are present on or in the floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

CAUTION: This instrument is not effective for the detection of tritium (i.e., H-3) or other pure beta emitters.

Note: Exhibit 6 is an example and the actual form is controlled in procedure SOP-R-SUR-001.

1. PHP Review the work plan, site data, URSA manual, applicable procedures, available detectors, and the URSA calibration data to determine:

- Location for background measurements, material backgrounds required, and sample/location data, as applicable.
- Applicable location and/or material backgrounds to be applied to the data collection.
- Equipment configuration (i.e., detector, URSA, cable, and computer).
- Applicable geometry.
- Applicable URSA Daily Operational Checklog and Collection Documentation.

Note: To effectively use the URSA in the gross count mode a longer than normal cable may be needed.

2. PHP Provides the RCT with the data identified in steps 1, 6, and 12.

3. RCT Obtain the required equipment, sources, and datasheets per direction of the PHP and PM consistent with the referenced URSA Daily Operational Check Log and Collection Documentation (Exhibit 1).

4. RCT Complete the initial section of the Data Collection Datasheet (Exhibit 4) and enter the datasheet number. The portions dealing with the *ROI* and *smoothing factor* should be marked NA, unless used for other activities. In the peak data indicated the gross count data only. The calibration and setup addressed in Section 7.01 must have addressed collection of gross count data as one of the energy peaks.

Note: Continuation of this datasheet can be made as needed using Exhibit 4. When using continuation sheet, record the sheet number and the datasheet number, based on the previous page(s).

5. RCT Set up system at the location to be analyzed or at a location convenient for analysis of the samples, that minimizes background impacts.

6. RCT Record the following information for the :

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "N" to indicate that is a static count,
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and
- The count time indicated as "R-" followed by the *Dwell Time* value specified by the PHP.
- Describe the geometry being used, and
- Location number and map reference for each location.

Note: Record the data on the tuning source used with this equipment as the instrument check source or indicate "NA".

7. RCT Start the computer, turn on URSA, and start software once Windows has booted up.

8. RCT Select a detector/geometry. If the designated detector/geometry is not available, consult PHP to arrange for the addition of detector per SOP-R-MCA-1, URSA Setup and Calibration or, if qualified, implement this procedure to add detector.

Note: Exhibit 3 contains a sample of the URSA configuration log that is maintained at the back of the SOP manual for designation of detector/geometry configuration by the PHP.

9. RCT Enable high voltage and verify it is consistent with the URSA Daily Operational Check Log and Collection Documentation (Exhibit 1)

10. RCT If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery need to be replaced immediately) shut down URSA & computer, then sign and date the datasheet and store datasheet in accordance with applicable procedures and Project Management direction.

11. Under the *Utility* pull down select the *Multi Channel Scaling Mode.*

12. RCT Complete the initial setup by:
- Uncheck the *Time* block on the URSA screen,
- Set the *Dwell Time* to the value provide by the PHP,
- Check the *cpm* block for chart and ratemeter,
- Uncheck *scroll width* ,
- Set *autosave* to 60 seconds,
- Check the *autorange* option,
- Set meter response to 8 seconds,
- Set *scale max* to 10, and
- Set alarm level, as specified by the PHP or based on the RWP and/or the applicable safety and health plan.

The values and entries specified above maybe changed at the PHP directions, but note any changes in the remarks section.

13. RCT Move to the survey area location and click the *Start* button to begin data acquisition.

14. RCT Hold the detector face at the specified distance from the surface being measured. or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

15. RCT Scan at a rate of 1 inch every 2 seconds to give the instrument time to respond. Scan rates greater than two inches per second drastically reduce the probability of detection. The operator should monitor the analog meter reading to locate hotspots and the graphic plot.

16. RCT Once acquisition is complete. click on the *File* button and save the file as *csv* file and as a graphic file. File naming is typically the Datasheet Number followed by the dataset number. For background files the letter LB or MB are added to the location and material backgrounds, respectively. If the file has been collected before add an R and the revision number to the file.

Note: Scanning files are usually proceeded by an "R-". The csv file format maybe used to transfer the data to a spreadsheet. Indicates as sublocations or remarks when (i.e., *Elapsed Time*) is over areas of particular interest.

17. RCT If *Tuning* is required after this collection, configure the designated fine tuning source, and the detector consistent with the geometry data (see Exhibit 3); other go to Step 28.

18. RCT Click the *Start* button to begin data acquisition.

19. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

20. RCT Record the designated peak Before section of the first available *Tuning* data line on the bottom of the datasheet (see Exhibit 4).

21. RCT Click on the *Fine* button on the button bar. A small window will pop up and display an isotope selection drop-down menu and an energy peak selection drop-down menu. The hardware settings panel will also open along the bottom of the spectrum display, but only the "Fine Gain Adjust (±64)" will be active.

22. RCT Select an isotope and an energy peak from the drop-down menus.

23. RCT Click on the Fine Tune button.

Note: The corresponding isotope source must be positioned consistent with geometry relative to the detector in order for the fine tuning to be successful.

24. RCT A series of acquisitions will follow until the most accurate fine gain adjustment is achieved. This could take several minutes. A "Fine Gain Adjustment Complete" message will appear when the procedure is done, if not consult PHP to arrange recalibration of this configuration or . per SOP-R-MCA-1, URSA Setup and Calibration or if qualified implement this procedure. Sign and date the data collection datasheet and store in accordance with applicable procedures and Project Management direction, then terminate the procedure

25. RCT Click the *Start* button to begin data acquisition.

26. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

27. RCT Record the designated peak After section of the first available *Tuning* data line on the bottom of the datasheet (see Exhibit 4).

28. RCT Record the highest count rate for the location in the "Value" column and an "A" followed by the total counts over the total time in the "Channel" column. This can be done while the report is being printed out in Section 7.07.

29. RCT If additional data is to be taken go to Step 13.

30. RCT Return to area where a printer is available and attach a printer to the computer.

31. RCT Start the computer and URSA software operation.

32. RCT Transfer copies of all data files to backup files (preferably duplicate).

33. RCT Print the graphics file for the data points and attach them to the Surface Radiation Field Measurement Datasheet.

34. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

Note: The page count t for the associated attachments should be indicated in the remarks section or at the bottom of the datasheet. They are not included in the page count of the datasheet.

35. FS Review and if completed properly, sign and date the datasheet, then store this in-process record in accordance with applicable Parsons and project procedures and client requirements.

36.	PHP	Review the datasheet per Section 7.08, as applicable, and once any data anomalies have been resolved, sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.
37.	General	The data on the datasheet should not be release to the client until Step 36 has been completed.

7.06 Use of URSA In Gross Count Mode For Static Counts

Note: Typically the static gross counts will be used to provide data for the assessment of decay constants for identification of short-live radionuclides including addressing the portion of the activity being counted related to radon progeny.

Note: The operation of the URSA is based on Windows based interactive computer screens, the steps below provide general direction on operation and are supplemented by the onscreen information and the URSA manual. Section 7.04 contains steps that are integrated into this process if an existing spectrum collection activity is to be restarted.

Note: When using a 60 cycle A.C. source the power source may generate low level peaks every 60 cycles which may impact data quality. Thus the resulting data should be reviewed for this impact and the impact should be part of the background data.

Note: This instrument will be used to determine if radiological contamination (photon-emitting radioisotopes) are present on or in the floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

CAUTION: This instrument is not effective for the detection of tritium (i.e., H-3) or other pure beta emitters.

Note: Exhibit 6 is an example and the actual form is controlled in procedure SOP-R-SUR-001.

1. PHP Review the work plan, site data, URSA manual, applicable procedures, available detectors, and the URSA calibration data to determine:
   - Count (i.e., Acquisition) times and location for collection of background counts, material backgrounds, and sample/location data, as applicable.
   - Applicable location and/or material backgrounds to be applied to the data collection.
   - Equipment configuration (i.e., detector, URSA, cable, and computer).
   - Applicable geometry.
   - Applicable URSA Daily Operational Checklog and Collection Documentation.

   Note: To effectively use the URSA in the gross count mode a longer than normal cable may be needed.
2. PHP Provides the RCT with the data identified in steps 1, 6, and 12.
3. RCT Obtain the required equipment, sources, and datasheets per direction of the PHP and PM consistent with the referenced URSA Daily Operational Check Log and Collection Documentation (Exhibit 1).
4. RCT Complete the initial section of the Data Collection Datasheet (Exhibit 4) and enter the datasheet number. The portions dealing with the *ROI* and *smoothing factor* should be marked NA, unless used for other activities. In the peak data indicated the gross count data only. The calibration and setup addressed in Section 7.01 must have addressed collection of gross count data as one of the energy peaks.

   Note: Continuation of this datasheet can be made, as needed, using Exhibit 4. When using continuation sheet, record the sheet number and the datasheet number, based on the previous page(s).
5. RCT Set up system at the location to be analyzed or at a location convenient for analysis of the samples, that minimizes background impacts.
6. RCT Record the following information for the :
   - Project and Building/area information,
   - Datasheet number and page,
   - Print the name of the surveyor and FS,
   - Instrument "Type" and the units of the "Value" it provides,
   - A "N" to indicate that is a static count,
   - If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and
   - The count time indicated as "S-" followed by the *Dwell Time* value specified by the PHP,
   - Describe the geometry being used, and
   - Location number and map reference for each location.

Note: Record the data on the tuning source used with this equipment as the instrument check source or indicate "NA".

7. RCT Start the computer, turn on URSA, and start software once Windows has booted up.

8. RCT Select a detector/geometry. If the designated detector/geometry is not available, consult PHP to arrange for the addition of detector per SOP-R-MCA-1, URSA Setup and Calibration or, if qualified, implement this procedure to add detector.

Note: Exhibit 3 contains a sample of the URSA configuration log that is maintained at the back of the SOP manual for designation of detector/geometry configuration by the PHP.

9. RCT Enable high voltage and verify it is consistent with the URSA Daily Operational Check Log and Collection Documentation (Exhibit 1)

10. RCT If at anytime during the use of the URSA the voltage fall below 9.5 volts (i.e., the battery need to be replaced immediately) shut down URSA & computer, then sign and date the datasheet and store datasheet in accordance with applicable procedures and Project Management direction.

11. Under the *Utility* pull down select the *Multi Channel Scaling Mode.*

12. RCT Complete the initial setup by:

- The *Time* block on the URSA screen and energy the count time indicated by the PHP,
- Set the *Dwell Time* to the value provide by the PHP,
- Check the *count* block for chart and *cpm* for the ratemeter,
- Uncheck the *scroll width*,
- Set *autosave* to 600 seconds,
- Check the *autorange* option,
- Set meter response to 8 seconds,
- Set *scale max* to 10, and
- Set alarm level, as specified by the PHP or based on the RWP and/or the applicable safety and health plan.

The values and entries specified above maybe changed at the PHP directions, but note any changes in the remarks section.

13. RCT Obtain any jigs needed to establish the geometry and position the sample in the geometry.

14. RCT Place the detector in the defined geometry.

15. RCT Click the *Start* button to begin data acquisition.

16. RCT Record the count rate in the "Value" column and an "A-" followed by the counts and elapsed time in the "Channel" column, then note "count start" in the remarks section. The system will continue unattended counting until the total count time has elapsed.

17. RCT Return several times during the count to record the count rate in the "Value" column and an "A-" followed by the counts and elapsed time in the "Channel" column.

Note: This action is to provide background data in event of a system failure, this step maybe eliminated at the direction of the PHP.

18. RCT Once acquisition is complete, click on the *File* button and save the file as *csv* file and as a graphic file. File naming is typically the Datasheet Number followed by the dataset number. For background files the letter LB or MB are added to the location and material backgrounds, respectively. If the file has been collected before add an R and the revision number to the file.

Note: Static files are usually proceeded by an "S-". The csv file format maybe used to transfer the data to a spreadsheet. Indicates as sublocations or remarks when (i.e., *Elapsed Time*) is over areas of particular interest.

19. RCT Record the count rate in the "Value" column and an "A-" followed by the counts and elapsed time in the "Channel" column, then note "final count" in the remarks section.

20. RCT If *Tuning* is required after this collection, configure the designated fine tuning source, and the detector consistent with the geometry data (see Exhibit 3); other go to Step 28.

21. RCT Click the *Start* button to begin data acquisition.

22. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

23. RCT Record the designated peak Before section of the first available *Tuning* data line on the bottom of the datasheet (see Exhibit 4).

24. RCT Click on the *Fine* button on the button bar. A small window will pop up and display an isotope selection drop-down menu and an energy peak selection drop-down menu. The hardware settings panel will also open along the bottom of the spectrum display, but only the "Fine Gain Adjust (±64)" will be active.

25. RCT Select an isotope and an energy peak from the drop-down menus.

26. RCT Click on the Fine Tune button.

Note: The corresponding isotope source must be positioned consistent with geometry relative to the detector in order for the fine tuning to be successful.

27. RCT A series of acquisitions will follow until the most accurate fine gain adjustment is achieved. This could take several minutes. A "Fine Gain Adjustment Complete" message will appear when the procedure is done, if not consult PHP to arrange recalibration of this configuration or . per SOP-R-MCA-1, URSA Setup and Calibration or if qualified implement this procedure. Sign and date the data collection datasheet and store in accordance with applicable procedures and Project Management direction, then terminate the procedure

28. RCT Click the *Start* button to begin data acquisition.

29. RCT Once the acquisition is complete use the cursor to obtain the designated peak count rates based on the current energy calibration.

30. RCT Record the designated peak After section of the first available *Tuning* data line on the bottom of the datasheet (see Exhibit 4).

31. RCT Record the highest count rate for the location in the "Value" column and an "A" followed by the total counts over the total time in the "Channel" column. This can be done while the report is being printed out in Section 7.07.

32. RCT If additional data is to be taken go to Step 13.

33. RCT Return to area where a printer is available and attach a printer to the computer.

34. RCT Start the computer and URSA software operation.

35. RCT Transfer copies of all data files to backup files (preferably duplicate).

36. RCT Print the graphics file for the data points and attach them to the Surface Radiation Field Measurement Datasheet.

37. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

Note: The page count t for the associated attachments should be indicated in the remarks section or at the bottom of the datasheet. They are not included in the page count of the datasheet.

38. FS Review and if completed properly, sign and date the datasheet, then store this in-process record in accordance with applicable Parsons and project procedures and client requirements.

39. PHP Review the datasheet per Section 7.08, as applicable, and once any data anomalies have been resolved, sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

40. General The data on the datasheet should not be release to the client until Step 39 has been completed.

7.07 Print Sample Data

1. RCT Return to area where a printer is available and attach a printer to the computer.

2. RCT Start the computer and URSA software operation.

3. RCT Transfer copies of all data files to backup files (preferably duplicate).

4. RCT If PHP or PM indicates that background should be electronically subtracted in the documentation click the *File* button and select *Load Spectrum as Background* then load the designed file.

5. RCT Click the *File* button and access one of the spectra collected in this datasheet, using the *Load Spectrum to Live* option.

6. RCT Print the *Sample Data* option.

7. If PHP or PM indicates that the spectrum should be documented click the *File* button and select *Print Spectrum*.

8. RCT Click the *print* button.

9. RCT If the active background file should not be used for the next data file to be printed, click the *File* button and select *Clear Background*.

10. RCT Repeat steps 4 to 9 until copies of all the datafiles collected have been printed.

11. RCT Attach these data reports and any associated spectra to the back of Exhibit 4.

12. RCT Store the documentation and files in accordance with applicable procedures and Project Management direction, and terminate this activity.

7.08 Data Verification

This is the initial step in the verification and validation of the data generated by the URSA for various samples and locations. The analysis process (e.g., Guidance for Spectrum Analysis Process) will address the balance of the data verification and validation process.

1. PH On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibits 1 and 4) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).

2. PH Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.

3. Review the data for the following technical considerations:

- Are the data technical consistent,
- Are the background values credible and are the background data consistent with the statistical variability expected,
- Are the expected progeny present and in the appropriate ratios,
- Are the expected background radionuclides present,
- Are there any radionuclides identified or present in concentrations that are not credible or at least require followup,
- Have appropriate backgrounds data set been obtained,
- It there consistency between these values and the other survey data,
- Are the radionuclides present in credible relative ratios,
- Is additional count time required to resolve spectra appropriately,
- Are there unidentified peaks that require resolution,
- Are there potential mis-identified peaks (e.g, impact of interferences),
- For static gross counts does the decay behavior appear consistent with credible decay series,
- For scanning gross counts does the ranges and variability of the count rate appear to be credible,
- Does the equipment appear to be functioning properly,
- Were any technical concerns/inconsistencies appropriately followed up on and resolved,
- Has the appropriate quality control/verification samples been taken,
- Are there any other outstanding technical, operational, or quality issues associated with the data.

4. PH If there are problems or potential problems associated the data, the PH initiates the Guidance for Spectrum Analysis Process (Woolfolk, 2000), other SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.

5. PH If the data does not have any outstanding problems, the PH signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.

6. PH Documents the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification and signs and dates the data sheets as verified (i.e., verified pending resolution of outstanding NCRs) and stores the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure

8.0 RECORDS

Exhibits 1, 2, 4, and 6 and any applicable associated NCRs are the quality records generated by this procedure. Exhibit 3 are informational listing maintained in the instrumentation data section at the back of the SOP manual. These are not quality records and are there only for convenience. The quality assurance documentation of the calibrations (i.e., energy and activity) with the associate ROIs calibration data sheets are generated by SOP-R-MCA-1 and the verified and validated software associated with the URSA. These listings (i.e., Exhibit 3) in the SOP manual are only there to assist the user in locating the required information in the computer.

Exhibit 1

PARSONS	URSA DAILY OPERATIONAL CHECK LOG AND COLLECTION DOCUMENTATION	SOP-R-MCA-2-1 - ______ Revision 0

Section 1

Project:				No.	
Initiated by (print):				Date:	
Detector Type			Detector Model		
Detector SN		Geometry		Smoothing Factor	
URSA SN		ROI			
Location			Background Location/File		
Location Subdivision		L-1	Background Material /File		M-1
		L-2			M-2
		L-3			M-3
		L-4			M-4

Section 2

Confirm & Record URSA Detector Designation (see data above)		High Voltage Enabled	Yes	No	
Check Source(s) (S/N & Activity)		(dpm)		(dpm)	
		(dpm)		(dpm)	
Power (volts)		Source	DC	AC	Battery Replaced Yes No

Check/Tuning Source Results Pre-Tuning (Optional)						Count time (sec)	
Peak's Energy (channel)							
Count							

Check/Tuning Source Post Tuning (Optional)						Count time (sec)	
Peak's Energy (channel)							
Count							

Background Location						Count time (sec)	
Peak's Energy (channel)							
Count							

Check Source Control Chart with 2 &	Yes	No	If No. obtain initials of PHP prior to use	Background Control Chart with 2 &	Yes	No	If No, obtain initials of PHP prior to use
Energy Calibration Date		Verified	Yes / No	Fine Tuning Completed		Yes	No
Activity Quantification Required	Yes	No	In Yes Record Calibration Date and Verify:		Verified	Yes	No

Check/Tuning Source Results End-of-Shift-Tuning (Optional)						Count time (sec)	
Peak's Energy (kev)							
Count							

Completed by (signature)		Date	

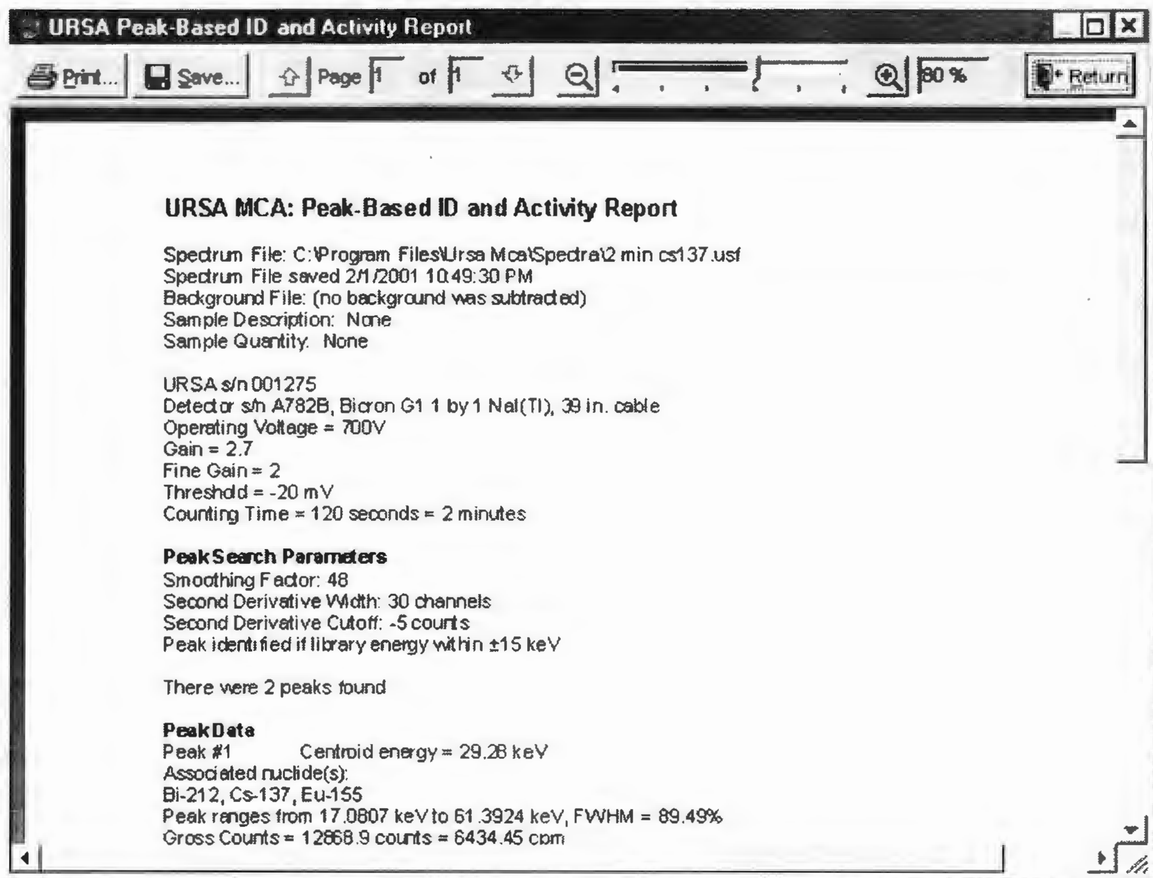
Data Verified

HP (Print)		HP Signature		Date:	

P:\PIT\Projects\SENECA\SEAD-48\Workplan\instrument procedures\URSA-2B.doc

Exhibit 2

URSA MCA: Peak-Based ID and Activity Report



URSA MCA: Peak-Based ID and Activity Report

Spectrum File: C:\Program Files\Ursa Mca\Spectra\2 min cs137.usf
Spectrum File saved 2/1/2001 10:49:30 PM
Background File: (no background was subtracted)
Sample Description: None
Sample Quantity: None

URSA s/n 001275
Detector s/n A782B, Bicron G1 1 by 1 NaI(Tl), 39 in. cable
Operating Voltage = 700V
Gain = 2.7
Fine Gain = 2
Threshold = -20 mV
Counting Time = 120 seconds = 2 minutes

Peak Search Parameters
Smoothing Factor: 48
Second Derivative Width: 30 channels
Second Derivative Cutoff: -5 counts
Peak identified if library energy within ±15 keV

There were 2 peaks found

Peak Data
Peak #1 Centroid energy = 29.28 keV
Associated nuclide(s):
Bi-212, Cs-137, Eu-155
Peak ranges from 17.0807 keV to 61.3924 keV, FWHM = 89.49%
Gross Counts = 12868.9 counts = 6434.45 cpm

Exhibit 3

Table of Detector & ROI Configurations With Supporting Data

PARSONS	Current URSA Detector Configuration Log		SOP-R-MCA-2-2 -__________ Revision 0	
URSA S/N:		Sheet:		of
Detector Geometry Configuration				
No.	Description (i.e., Detector and Geometry Description.		Expiration Date	

Note: The Detector Configuration Number is:

Detector Model Designator-Detector S/N#-Source Type Designator-Expiration Date (YYMMDD format)-Sequence Number or other unique identifier (e.g., FID-34556-V-011231-1). Where:

Designator Key		
Designator	Item	Type
FID	Fidler	Detector
NAI2X2	2" X 2" NaI	Detector
NAI1X1	1" X 1" NaI	Detector
ANT	Anthracene Solid State	Detector
P	Point	Source
S	Surface	Source
V	Volume	Source
Designator may be added by PHP as necessary using a similar format without revision of this procedure.		

Table of ROIs

PARSONS	Current URSA ROI Log			SOP-R-MCA-2-3 -__________ Revision 0	
URSA S/N:		Sheet:		of	
ROI Description					
No.	Description (i.e., Radionuclides and energy range in KEV)	Fine Tuning Source Number	Expiration Date		

Note: The ROI number is:

- Atomic number (i.e., use include preceding zero for 3 digits, e.g., for hydrogen 001) of the radionuclides in order (for up to the first 3 radionuclides), a dash, then the expiration date (YYMMDD format), a dash, a sequence number or other unique identifier. (e.g., 055092-011231-1 for a Cs and U ROI). When it is operationally helpful the unique identifier could be the last number of the atomic weight of one of the radionuclides.

Exhibit 4

PARSONS	URSA DATA COLLECTION DOCUMENTATION	SOP-R-MCA-2-4 -__________ Revision 0

Section 1			Sheet 1 of ____
Initiated By:		Date	
Ref. Datasheet	SOP-R-MCA-2-1-__________	Date	

Data Collection (no entires required in the last 3 column or the Tuning data section)

No.	Location	Type*	Count Time (sec.)	Output File Name	Tuning No.	Background Location	Background Material

Related Tuning Data (enter only data needed)							Count Time (seconds)				
T1	Peak's Energy (channel)	Before					After				
	Count										
T2	Peak's Energy (channel)										
	Count										
T3	Peak's Energy (channel)										
	Count										
T4	Peak's Energy (channel)										
	Count										

Signature		Date	

Verified By

HP (Print)		HP Signature		Date:	

* LB = location background, MB = material background, SD = sample data, LD =location data)

EXHIBIT 4 (continued)

PARSONS	URSA DATA COLLECTION DOCUMENTATION (continued)	SOP-R-MCA-2-4 -_______ Revision 0
Data Collection		Sheet ____ of ____

No.	Location	Type*	Count Time (sec.)	Output File Name	Tuning No.	Background Location	Background Material

Related Tuning Data (enter only data needed)							Count Time (seconds)					
T_	Peak's Energy (channel)	Before					After					
	Count											
T_	Peak's Energy (channel)											
	Count											
T_	Peak's Energy (channel)											
	Count											
T_	Peak's Energy (channel)											
	Count											
T_	Peak's Energy (channel)											
	Count											

Signature		Date	

Verified By					
HP (Print)		HP Signature		Date:	

* LB = location background, MB = material background, SD = sample data, LD =location data)

Exhibit 5
Control Chart

Parameter Being Tracked	Cs-137 0.661 MeV peak counts. post fine tuning
Electectronics	
Instrument Type	URSA-MCA
Model Number	Universal Radiation Spectrum Analyzer
Manufacturer	RSA
Serial Number	20291
Detector	
Instrument Type	Fidler
Model Number	M-23
Manufacturer	Ortec
Serial Number	X-111
Geometry	Center Line Area Source at 4"
ROI	Cs-137 0.661 MeV peak
Count Data	
	Mean= 897.1667
	STDEV= 71.46025

Date/Time	Data Number	Data	Pull Block	Status
1/1/00 0:00	1	905		
1/5/00 0:00	3	1001		
1/6/00 0:00	4	787		
1/7/00 0:00	5	923		
1/10/00 0:00	6	911		OK
1/2/00 0:00	2	856		

Exhibit 5 (continued)
Control Chart

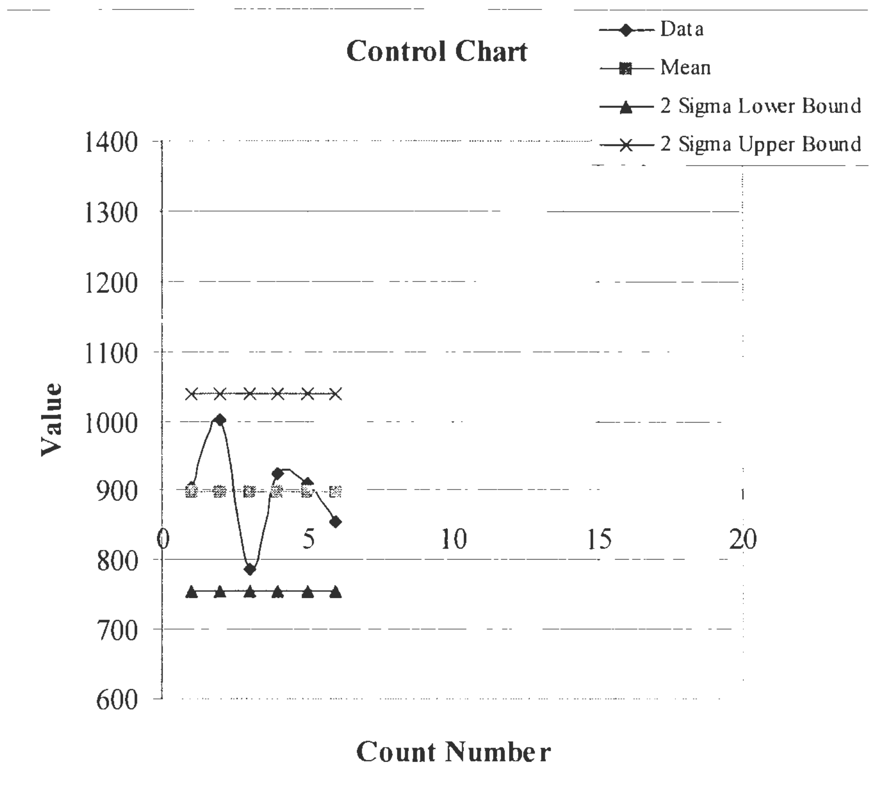


Exhibit 6

PARSONS

Surface Radiation Field Measurement Datasheet

SOP-R-SUR-1-2- ____________ Revision 0
Page ___ of ___ Date: ____________

Project Title: ______________________ Surveyor (print): ____________ Surveyor Signature: ____________ Date: _____

Project Number: ______________________ Verifier (print): ____________ Verifier Signature: ____________ Date: _____

Building/area/Floor: ______________________

Room/Unit Designation: ______________________ Complete FS (print): ____________ FS Signature: ____________ Date: _____

Measurement Location		Direct Surface Reading static Y/N ☐ Type _______ Count Time (M) _____			Direct Surface Reading static (Y/N) ☐ Type _____ Count Time (M) _____			Alt. Distance (optional) ________cm (left instr) Alt. Distance (optional) ________cm (right instr)
No	Per Reference Map	Value (________)	Channel (optional)	Instr. #	Value (______)	Channel (optional)	Instr. #	Remarks
Instr. Check Source								

Specialized Geometry (optional):

Exhibit 6 (continued)

PARSONS

Surface Radiation
Field Measurement Datasheet (continued)

SOP-R-SUR-1-2- ______________ Revision 0
Page ___ of ___ Date: ______________

Measurement Location		Direct Surface Reading			Direct Surface Reading			Remarks
No	Per Reference Map	Value (______)	Channel (optional)	Instr. #	Value (_____)	Channel (optional)	Instr. #	

Table of Contents

1.0 PURPOSE

This procedure provides the requirements for identifying sampling and data collection locations consistent with the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (NRC, 1997). The procedure will provide a documented grid for the collection of survey data or sampling consistent with:

- the risks of the presence of radiological material,
- the size and shape of the area,
- applicable regulatory guidance and requirements, and
- good health physics practices.

2.0 SCOPE

This procedure is applicable to the survey and sampling of soil surfaces and the surfaces of structures to decommissioning and/or impact assessment under the requirements of the DOE, NRC, or EPA. This procedure maybe applied to other activities at the discretion of the Project Manager. This procedure can only be implemented by trained and qualified personnel.

3.0 REFERENCES

1. NRC, 1997. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Final, December 1997.

2. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, *Quality Assurance Manual*, Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

4.0 DEFINITIONS

1. **Biased location** is a location that is selected in a manner that is based on a systematic algorithm. For this procedure it implies selection of a location using an algorithm that is not based on a random number.

2. **Classification** of potentially contaminated areas is based on the potential for contamination to be present in the area. The classification consists of 3 levels of risk. Areas not meeting the requirements for these three levels are unimpacted.
   - Class 1 areas: Areas that have been decontaminated, are potentially contaminated, or are contaminated. Contaminated implies contamination levels in excess of the applicable derived concentration guidelines (DCGLs).
   - Class 2 areas: Areas where radioactive material maybe present but are not expected to exceed the DCGLs.
   - Class 3 areas: Areas where radioactive material may been present and either none or a small fraction of the DCGLs remains.

3. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.
   - The materials associated with the radiation source and any associate container including back-scatter surfaces.

4. **Lower Wall** sections are those portions of the walls less than 6 feet above the floor surface.

5. **Random location** is a location that is selected in a manner that essentially removes the bias from the results. For this procedure it implies selection of a location using an algorithm based on a random number from a random number table like those in Attachment A of this procedure.

6. **Survey Units** localized areas that have similar characteristics and the same classification, which will be addressed as a unit in the sampling and survey activities. Survey units must meet the criteria in Table 1 Normal Survey Unit Size Requirements.

7. **Upper Wall** sections are those portions of the walls more than 6 feet above the floor surface.

Table 1 Normal Survey Unit Size Requirements

Class	Land Surface Area (m^2)	Structure Area (m^2)	Land Surface Grid Size (m)	Structure Surface Grid Size (m)
1	α 2000	α 100	10 to 20	1 to 2
2	2,000 to 10,000	100 to 1,000	10 to 20	1 to 2
3	no limit	no limit	20 to 50	5 to 10

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

1. The minimum number of samples will be established by the work plan or equivalent document for the project or specifically provided by the PHP.

2. Only qualified and trained personnel are allowed to implement this procedure.

3. Grids should typically be either square or triangular. This procedure addresses the use of square grids, if a triangular grid is used the PHP will provide specific instructions on changes to this procedure to be implemented.

4. The Grid size (i.e., L) should be approximately $L \cong SQRT(A/n)$ where A is the area of the survey unit and n is the number of samples needed. The size of the grid can be rounded to a reasonable value for field implementation, as long as the minimum number of samples is still taken.

5. The survey units and grid sizes should not exceed the values specified in Table 1 Normal Survey Unit Size Requirements and typically be consistent with this guidance.

6. The grid layout shall be clearly documented and tied, to the extent practicable, to enduring landmarks to the locations can be found after termination of this process.

6.0 RESPONSIBILITIES

6.1 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the selection and layout of the grid and implementation of the sampling or survey are consistent with the technical requirements of this procedure, the regulations, and good health physics practices.

2. Training the Technicians (Techs) in the proper use of this procedure.

3. Providing independent review of the documentation and data to ensure it is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

6.2 Technicians (Techs) are responsible for:

1. Implementing this procedure and the applicable training.

2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

3. Documenting data collected in accordance with appropriate regulations and procedures.

4. Reporting out of specification conditions to the Project Health Physicist and/or Field Supervisor.

6.3 Project Manager (PM) (or designee, such as the field supervisor)

1. Provides required materials and trained/qualified personnel for implementation of the task.

2. Provides operational review of the project specific activities for these data collection activities.

3. Determines the applicability of this procedure beyond the areas specifically identified in Section 2.0.

6.4 Field Supervisor (FS)

1. PM site representative and responsible for routine supervision of the task.

2. Verification of task completion.

7.0 PROCEDURES

Note: If at anytime during this procedure there are conditions that may impact the results note this information in the comment section or on the back of the applicable datasheet.

7.1 Establishing a Grid

Note: It is acceptable to add attachments containing the information to the Sampling/Survey Grid Datasheet and then reference this attachment on the datasheet.

1 PHP Reviews the work plan, site data, regulatory requirements, customer requirements, and other applicable documentation with the PM and establishes the survey units, survey unit classification, sample depth (e.g., trench depth, lift size), the number of biased sampling points, the number of random (unbiased) sampling points, and the algorithms for defining the sampling points.

2 PHP Provide the Tech with the data identified in step 1.

3. Tech Obtain the Sampling/Survey Grid Datasheet, measuring device, and grid marking equipment.

4. Tech Selects the landmarks on which to base the grid in consultation with the PHP, Field Supervisor, and PM.

5. Tech Determines the grid size based on the guidance in the Sampling/Survey Grid Datasheet.

   Note: When selecting grid sizes for walls, attempt to make the grid points break near the 6 foot (i.e., height) to facilitate sample sorting.

6. Tech Layout the grid and mark consistent with the Field Supervisors direction and the information on the Sampling/Survey Grid Datasheet.

7. Tech Document (i.e., with verbal description and graphical description) the grid on the Sampling/Survey Grid Datasheet, if non-surface samples or survey points are to be addressed indicate the applicable depths, if not survey dependent. On the graphic description always include reference to the designated landmarks, grid area designations, and a north arrow should be shown on the layout drawing. Normally the top of the sheet should be north. In the verbal section be sure to specific units of the specified grid area (i.e., areal units).

   Note: When specifying survey points provide the location as a set of (X,Y,Z) coordinates. Where X applies to the most north-south coordinate, Y applies to the most east-west coordinate, and Z is the depth into the soil. If points above the soil surface or facility floor are included the value of Z should be preceded by an "a". The units of the coordinates must be documented on the datasheet and should be the same. The relative origin of the coordinates [i.e., location (0,0,0)] is the most southwest corner of the grid. If grids are number this should be a corner of grid "1" and should increase from west to east and then from south to north. If the sampling points are typically on a single plane a two-dimensional coordinate system may be applied, and off plane samples given a specific designations that are attached to the location designations.

Walls and ceiling should be shown as 3-dimensional unfoldings and have the same system except the coordinates should be proceeded by the surface designation from the graphical description such as w1, w2, w3, w4, c1, and c2. Interior walls maybe shown separately from the unfolding but the designation must be clearly tied to the appropriate side on the graphical description of the survey unit. Additional, pages maybe attached as needed to document the layout.

Note: If the grids in a survey unit, for which the grid to be sampled are randomly selected or selected algorithm requiring unique consecutive numbering, ensure that the grids are consecutively number or a consecutive number cross reference is provided to select the grids for sampling.

8. Tech — Obtain PHP verbal concurrence with the grid layout prior to the collection of any samples or survey data.
9. Tech — Sign and date the grid layout portion of the Sampling/Survey Grid Datasheet.
10. FS — Sign and date the grid layout portion of the Sampling/Survey Grid Datasheet.

7.2 Designation of Sample Locations

Note: This section of the procedure maybe implemented in conjunction with the sampling/survey activity. It is acceptable to add attachments containing the information to the Sampling/Survey Grid Datasheet and then reference this attachment on the datasheet.

1 Tech — Documents the algorithm for biased and unbiased sampling/survey locations, for sampling/survey locations not addressed by the random sampling process addressed in this procedure.

2 PHP — Provides support to the Tech, as needed, to resolve questions relating to sampling locations.

3. Tech — Obtain the required equipment for marking sampling locations.

4. Tech — If sampling of all the grids is not required for some sampling/survey activities then indicate the percentage or number of grids sections that will be addressed.

   Note: If the survey unit has groups that would be more affectively addressed as subunits they can be addressed separately (e.g., walls above and below 6 feet). Then the data consolidated on the Sampling/Survey Grid Datasheet.

5. Tech — If a special algorithm is used to select these grids sections then document and implement this algorithm and then go to step 7.

6. Tech — From a table of random numbers of integers (see Exhibit 2) obtain a random number for each grid section to be sampled plus one for each of the biased sampling/survey location grid sections. Ignore all duplicate numbers or numbers beyond the number of grid sections. The starting point for selection can be chosen at random or per direction of the PHP. However, once the first number has been chosen then the consecutive number in the table needs to be used for the balance of this procedure. Numbers, that are not applicable to the grid should be ignored and proceed to the next consecutive number.

   Note: If there are more than 100 grid sections obtain a table of random number from 1 to the number of grid sections from software, such as Excel, or a table of random integers from another source and provide a reference for the source and a copy of the table used.

7. Tech — Document the grid section to be sampled and the additional grid location selected for each of the biased samples. If there are subgroups used provide this data.

   Note: The additional grid locations (i.e., supplementary grid locations) associate with the biased samples will only be used if the biased sample/survey grid location was also designated by the random sampling/survey list.

8. Tech — Repeat steps 5 to 6 as needed to address all sampling units or subunits being addressed.

9. Tech — If the PHP has provided a specific algorithm for establishing sampling locations within the grid document on the datasheet and implement this algorithm and then go to step 13.

10. Tech — Obtain two random numbers from the 0.0 to 1.0 decimal random number table (Exhibit 3). The starting point for selection can be chosen at random or per direction of the PHP. However, once the first number has been chosen then the consecutive number in the table needs to be used for the balance of this procedure.

11. Tech — Multiply each of these random numbers by the length of the grid sides and these are now the X and Y coordinates of the sample location with the origin in the southwest most corner of the grid.

12. Tech — For each grid location, for which this sampling point applies based on PHP instructions, mark the location with a sample/survey number (see Exhibit 4) and document the location and the sample number on the datasheet.

    Note: Ensure the supplementary grid locations are clearly identified so that they can be added to the sampling/survey suite as a randomly selected grid becomes a grid sampled based on the biased criteria.

13. Tech — Repeat this process until all locations have been marked.

    Note: Ensure the supplementary grid locations are clearly identified so that they can be added to the sampling/survey suite as a randomly selected grid becomes a grid sampled based on the biased criteria.

14. Tech — Sign and date the sample location section of the datasheet and submit to the FS.

15. FS Review and if completed properly, sign and date the sample location section of the datasheet, then stores this in-process record in accordance with applicable Parsons and project procedures and client requirements.
16. PHP Review the datasheet per Section 0, and once any data anomalies have been resolved sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.
17. General The data on the datasheet should not be release to the client until Step 16 has been completed.

7.3 Data Verification

This is the initial step in the verification and validation of the data generated by this procedure, the final steps will be addressed by the verification and validation process describe in the applicable workplan or similar document.

1. HP On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibit 1) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).
2. HP Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.
3. HP Review the data for the following technical considerations:

   - Are the data technically consistent,
   - Was the algorithm used for selection of the locations valid and correctly implemented,
   - Were appropriate random numbers used in establishing locations,
   - Were appropriate sample numbers established and identified,
   - Were any technical concerns/inconsistencies appropriately followed up on and resolved, and
   - Are there any other outstanding technical, operational, or quality issues associated with the data.
4. HP If there are problems or potential problems associated the data, the HP initiates any designated SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.
5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.

6. HP Documents the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification and signs and dates the Datasheets as verified (i.e., verified pending resolution of outstanding NCRs) and stores the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure

8.0 RECORDS

Exhibit 1, the associated random number list if those in the procedure were not used, and any applicable associated NCRs are the quality records generated by this procedure.

Exhibit 1

PARSONS	Sampling/Survey Grid Datasheet			SOP-R-MAR-1-1 - Revision 0
Field Supervisor (print)		Number of attached pages		Page 1 of 2

Grid Development Section

Project:			No.				
Initiated by (print):				Date:			
Survey Unit:							
Classification		Number of Biased Samples		Number of Unbiased Samples			
Description of algorithm for grid (including depth data if any)				Unbiased Random	Yes		No
Describe Landmarks							
Grid Size =sqrt(A/S)		Total Samples (S)		Survey Unit Area (A)		Areal Units	
Field Supervisor (print)						Date	
Completed by (signature)			(signature)			Date	

Sample Location Section

Description of algorithm for sample (including depth data if any)									
Areal Fraction 1 for floors, soil surfaces, and walls below 6 feet (optional)		Areal Fraction 2 for ceilings, and walls above 6 feet (optional)		Id. No. Subgrouping uses (optional)		Percent (%) to be Sampled (optional)			
Grid Numbers to be Sampled									
The 2 decimal random numbers			X-coord.		Y-coord.		Z-coor.		Sheets of Add. Corrd.
Description of Sample/Survey Location Numbering:									
Comments									

Completed by (signature)	Date	

Data Verified

Field Supervisor (FS) (print)	(signature)		Date	
PHP (print)	(signature)		Date:	

PARSONS	Sampling/Survey Grid Datasheet		SOP-R-MAR-1-1 -__________ Revision 0
FS (print)		Initiated by (print)	Page 2 of 2

Grid Development Section

(include data on grid identifiers, landmarks, depth, and north-south arrow)

Exhibit 2

Table of Random Numbers Between 1 and 100

44	68	13	7	98	87	48	4	81	26	78	89	78	62	11	13	90	75	37	68	82	4	4	98	13	49	49	82
5	9	44	5	49	47	79	24	91	2	13	71	33	12	30	75	38	34	42	55	52	99	23	16	6	59	69	96
72	21	1	54	89	50	34	90	93	7	2	46	57	20	25	58	17	45	66	78	57	32	37	52	64	77	52	85
7	74	76	74	96	15	70	25	28	72	70	21	60	90	81	25	74	46	72	30	8	98	62	37	6	2	24	19
48	55	5	90	6	99	72	99	90	50	78	5	65	72	52	39	82	99	61	56	5	42	45	82	84	58	73	45
89	18	94	47	53	44	75	10	51	8	94	9	26	97	27	13	40	90	32	30	84	2	8	12	95	93	82	30
21	54	96	20	82	1	51	13	23	44	61	70	3	19	69	78	87	14	19	31	42	99	57	79	66	52	21	77
72	58	91	69	80	97	88	66	64	97	69	63	50	18	46	51	29	97	15	29	36	93	22	64	29	8	90	2
51	75	6	17	74	59	5	9	14	1	89	9	12	33	3	33	62	19	65	41	96	33	53	60	66	69	15	5
24	73	83	56	75	79	85	28	83	93	11	91	3	24	35	31	43	25	35	72	57	26	6	69	85	20	40	74
81	97	68	67	10	72	6	61	93	15	84	61	77	15	82	54	14	56	53	43	76	69	67	22	40	53	6	73
48	49	8	48	77	9	99	79	61	77	88	62	8	15	96	37	70	13	12	70	45	60	29	98	24	17	66	19
26	95	49	7	83	20	24	83	32	36	27	77	9	92	28	97	3	32	78	33	1	44	35	86	42	52	86	57
98	71	19	14	8	22	21	20	19	73	13	8	28	53	47	11	95	51	57	85	64	8	29	94	47	14	79	83
49	93	5	34	6	47	78	83	80	25	91	77	22	46	81	96	50	4	57	12	73	40	50	94	33	34	57	42
22	66	75	56	87	91	81	53	44	95	34	100	5	41	65	43	75	10	64	75	1	95	56	93	19	57	82	53
96	94	52	38	86	82	86	59	7	43	99	26	65	78	43	61	51	27	2	30	54	71	36	8	85	31	27	40
77	0	2	26	21	35	21	51	99	82	74	94	35	30	19	80	29	16	97	94	68	96	45	25	80	13	56	79
68	99	1	73	29	50	36	14	44	63	58	54	6	74	23	93	92	2	49	99	37	32	97	10	14	15	84	23
44	92	80	96	43	52	58	20	45	52	65	73	69	37	41	9	38	36	6	81	51	8	9	43	77	1	78	5
44	72	14	44	95	54	54	16	83	64	53	36	80	44	24	17	27	51	65	50	28	53	33	75	73	18	37	2
74	6	70	94	70	11	64	15	52	32	27	86	70	97	66	63	24	70	32	42	57	60	47	27	74	52	91	11
80	25	82	22	1	53	84	11	16	75	7	65	22	18	17	75	97	57	96	21	44	77	13	71	84	13	57	86
31	19	81	26	80	41	46	79	15	47	45	26	80	75	7	65	80	27	49	48	81	51	80	22	8	73	52	79
39	60	50	63	35	34	66	79	92	61	89	39	64	64	37	68	35	68	42	92	76	25	59	36	81	36	35	39
53	42	71	27	65	72	79	88	3	68	6	27	69	89	32	76	42	51	31	61	20	56	84	44	97	37	76	59
43	24	46	78	33	100	23	0	6	62	72	5	24	74	61	94	93	79	65	17	54	17	57	24	29	71	20	29
79	41	70	34	91	63	48	6	48	36	56	12	100	26	39	3	46	5	25	49	97	28	67	22	45	66	78	49
66	49	35	30	40	43	72	67	77	58	38	95	96	55	15	64	20	48	68	3	28	33	15	18	78	0	63	45
21	71	92	78	61	29	34	80	44	9	23	30	39	42	6	88	91	51	82	69	55	83	56	21	80	57	74	45
89	71	90	82	16	72	34	14	32	98	44	27	72	60	59	23	19	99	88	42	42	91	29	27	11	67	31	14
92	99	81	86	4	37	31	19	69	93	43	57	51	98	54	81	55	14	31	64	98	94	92	74	42	40	35	40
24	41	45	11	2	49	91	55	48	88	56	63	93	53	90	91	40	99	4	32	73	63	36	7	14	77	65	14
17	40	28	49	46	3	29	74	85	60	66	32	85	68	72	93	4	65	84	66	94	61	16	17	51	56	74	62
14	92	58	27	85	27	63	62	25	86	47	39	80	34	55	41	44	57	79	82	91	83	71	80	71	5	58	7
56	91	49	98	11	43	33	23	91	33	38	22	60	35	52	3	88	59	99	14	73	69	41	86	0	73	58	95
69	71	45	7	95	47	50	42	54	7	2	25	96	26	18	55	4	53	19	21	88	76	91	30	32	15	20	66
62	42	7	37	84	27	30	13	19	54	31	77	30	94	80	32	6	94	21	36	84	46	50	54	5	11	80	100
44	91	3	2	10	36	13	94	48	64	70	17	94	19	56	34	73	42	54	45	70	91	34	67	62	67	57	90
50	35	93	55	94	84	5	18	35	28	11	78	49	46	14	24	61	26	13	25	76	3	87	68	1	68	15	90
37	35	2	62	13	18	47	12	10	58	83	38	9	54	20	35	93	18	57	95	26	88	23	27	74	97	8	92
78	62	20	55	73	47	46	47	96	70	61	90	24	64	76	87	47	96	37	97	99	94	18	96	32	30	33	89
65	62	3	9	86	45	14	45	97	9	48	64	34	89	73	41	26	90	85	94	51	64	41	68	80	37	53	60
44	99	15	36	11	85	3	24	45	29	55	16	34	35	31	88	18	2	12	49	51	63	55	45	48	43	82	41
35	18	27	16	73	9	84	97	62	89	41	43	91	15	34	15	46	17	32	28	18	35	88	59	69	26	82	28
83	35	12	77	35	37	40	95	97	5	66	19	69	81	44	60	9	18	38	0	60	24	82	19	95	26	44	84
17	79	32	76	52	50	54	85	90	59	70	63	90	37	71	83	55	88	62	4	66	58	34	4	23	58	46	24
90	55	37	76	32	57	91	78	57	40	92	49	42	73	11	19	97	75	90	26	19	48	94	2	17	36	38	25
81	25	36	21	81	26	93	62	55	78	87	94	96	83	15	6	52	87	82	47	45	32	82	84	75	2	84	36
52	96	38	94	16	27	18	33	16	84	89	99	1	56	14	21	49	7	59	48	71	29	12	28	85	53	16	39
94	97	87	58	78	50	83	51	36	28	54	62	6	61	44	21	55	15	79	49	53	1	60	81	19	71	81	94
28	89	18	25	2	74	9	40	91	59	70	98	49	7	26	11	35	97	60	38	66	100	9	74	50	10	86	19
23	45	82	73	89	46	61	43	63	66	57	14	33	11	96	88	17	80	83	40	74	32	60	42	20	78	23	74
38	12	15	34	71	40	38	89	43	7	55	2	76	89	70	77	65	4	37	33	63	25	67	28	33	70	90	36
76	22	72	92	20	61	98	6	7	68	59	12	68	2	25	56	20	88	68	14	90	35	57	67	40	28	34	72
15	7	90	62	78	61	48	65	35	59	63	41	82	81	73	75	18	59	57	36	96	83	71	85	70	9	37	78
19	47	1	7	93	15	82	29	67	1	43	87	98	52	88	67	93	18	20	60	21	77	96	77	61	46	67	50
21	46	7	77	19	40	27	14	2	0	21	87	68	71	84	62	84	8	78	1	98	61	23	21	79	17	58	26
95	76	74	26	82	91	34	45	88	92	26	67	93	98	13	70	82	40	85	9	75	17	87	59	71	2	86	77

Exhibit 3

Table of Random Numbers Between 0 and 1

0.619	0.775	0.554	0.336	0.812	0.198	0.498	0.445	0.377	0.695	0.672	0.044	0.643	0.543	0.173	0.923	0.326	0.299	0.875	0.769	0.422
0.249	0.707	0.611	0.306	0.592	0.896	0.183	0.157	0.163	0.411	0.077	0.423	0.354	0.315	0.67	0.203	0.023	0.962	0.206	0.124	0.45
0.075	0.879	0.564	0.467	0.536	0.29	0.913	0.143	0.836	0.649	0.947	0.565	0.444	0.06	0.854	0.181	0.156	0.517	0.921	0.199	0.639
0.284	0.979	0.11	0.779	0.158	0.973	0.127	0.426	0.012	0.215	0.098	0.263	0.401	0.747	0.127	0.205	0.298	0.394	0.449	0.675	0.218
0.138	0.098	0.026	0.623	0.816	0.504	0.966	0.54	0.065	0.768	0.65	0.506	0.435	0.016	0.524	0.407	0.811	0.091	0.656	0.645	0.599
0.938	0.674	0.149	0.505	0.96	0.85	0.33	0.98	0.439	0.763	0.085	0.257	0.305	0.095	0.784	0.525	0.219	0.596	0.228	0.995	0.857
0.344	0.024	0.374	0.654	0.335	0.896	0.481	0.733	0.477	0.915	0.198	0.069	0.185	0.976	0.987	0.771	0.653	0.048	0.116	0.586	0.929
0.553	0.878	0.892	0.7	0.169	1	0.711	0.107	0.297	0.902	0.589	0.454	0.428	0.984	0.826	0.366	0.007	0.004	0.052	0.915	1
0.324	0.045	0.81	0.043	0.42	0.52	0.96	0.719	0.562	0.556	0.369	0.553	0.395	0.66	0.371	0.279	0.066	0.304	0.977	0.672	0.107
0.009	0.708	0.569	0.914	0.533	0.069	0.724	0.168	0.646	0.398	0.436	0.947	0.291	0.292	0.248	0.94	0.301	0.656	0.228	0.846	0.344
0.713	0.695	0.257	0.469	0.631	0.265	0.085	0.564	0.624	0.263	0.275	0.931	0.052	0.063	0.724	0.234	0.272	0.439	0.259	0.928	0.261
0.605	0.849	0.082	0.304	0.216	0.76	0.532	0.265	0.524	0.129	0.783	0.615	0.48	0.049	0.885	0.252	0.967	0.477	0.483	0.529	0.796
0.449	0.107	0.678	0.893	0.545	0.79	0.322	0.138	0.739	0.82	0.123	0.148	0.35	0.665	0.821	0.999	0.988	0.228	0.534	0.536	0.914
0.569	0.782	0.192	0.165	0.629	0.878	0.085	0.413	0.058	0.868	0.185	0.404	0.293	0.218	0.169	0.521	0.068	0.602	0.181	0.685	0.095
0.218	0.556	0.787	0.852	0.659	0.422	0.848	0.322	0.405	0.924	0.338	0.671	0.584	0.918	0.458	0.705	0.55	0.32	0.468	0.767	0.844
0.507	0.39	0.272	0.307	0.731	0.852	0.88	0.147	0.485	0.49	0.515	0.459	0.752	0.09	0.459	0.705	0.023	0.773	0.603	0.593	0.073
0.107	0.751	0.576	0.075	0.947	0.819	0.961	0.748	0.149	0.142	0.148	0.193	0.294	0.313	0.367	0.471	0.056	0.135	0.185	0.602	0.368
0.933	0.351	0.62	0.522	0.893	0.708	0.423	0.816	0.008	0.175	0.138	0.788	0.77	0.573	0.356	0.288	0.782	0.11	0.849	0.232	0.473
0.071	0.858	0.547	0.078	0.179	0.852	0.313	0.166	0.856	0.298	0.122	0.633	0.689	0.329	0.826	0.338	0.774	0.559	0.896	0.329	0.556
0.171	0.229	0.095	0.103	0.806	0.602	0.022	0.922	0.689	0.869	0.738	0.979	0.958	0.3	0.206	0.93	0.688	0.931	0.285	0.887	0.82
0.866	0.958	0.027	0.498	0.146	0.667	0.259	0.136	0.829	0.39	0.471	0.464	0.855	0.007	0.628	0.088	0.343	0.562	0.346	0.119	0.214
0.382	0.27	0.045	0.391	0.865	0.232	0.063	0.263	0.01	0.598	0.519	0.637	0.336	0.955	0.792	0.555	0.656	0.633	0.138	0.316	0.758
0.121	0.304	0.203	0.055	0.826	0.924	0.52	0.906	0.69	0.258	0.994	0.836	0.734	0.847	0.289	0.876	0.508	0.641	0.466	0.543	0.705
0.535	0.603	0.675	0.785	0.36	0.749	0.764	0.732	0.061	0.41	0.83	0.986	0.277	0.821	0.319	0.194	0.148	0.575	0.382	0.932	0.573
0.505	0.172	0.845	0.976	0.514	0.282	0.044	0.032	0.458	0.7	0.671	0.871	0.752	0.974	0.552	0.639	0.041	0.665	0.895	0.081	0.597
0.196	0.078	0.846	0.887	0.961	0.809	0.036	0.133	0.89	0.539	0.428	0.627	0.983	0.699	0.505	0.616	0.19	0.11	0.661	0.334	0.258
0.507	0.977	0.618	0.331	0.876	0.326	0.395	0.03	0.656	0.872	0.226	0.448	0.591	0.082	0.033	0.833	0.695	0.719	0.619	0.826	0.283
0.386	0.538	0.557	0.693	0.342	0.945	0.49	0.137	0.27	0.033	0.9	0.066	0.049	0.175	0.275	0.424	0.186	0.595	0.991	0.603	0.163
0.144	0.71	0.007	0.389	0.886	0.531	0.738	0.87	0.001	0.874	0.803	0.172	0.899	0.391	0.532	0.177	0.268	0.419	0.468	0.846	0.508
0.276	0.998	0.33	0.385	0.555	0.548	0.839	0.885	0.476	0.587	0.752	0.312	0.689	0.094	0.227	0.885	0.026	0.583	0.439	0.838	0.598
0.036	0.848	0.801	0.555	0.572	0.076	0.724	0.353	0.258	0.172	0.48	0.739	0.021	0.443	0.807	0.396	0.502	0.053	0.258	0.436	0.586
0.639	0.455	0.018	0.894	0.096	0.322	0.515	0.945	0.083	0.974	0.924	0.419	0.744	0.958	0.291	0.896	0.353	0.756	0.838	0.307	0.793
0.573	0.255	0.212	0.756	0.557	0.395	0.692	0.068	0.057	0.161	0.169	0.639	0.291	0.158	0.463	0.989	0.406	0.747	0.712	0.115	0.152
0.006	0.763	0.899	0.951	0.259	0.66	0.259	0.435	0.559	0.97	0.842	0.328	0.451	0.349	0.629	0.169	0.339	0.058	0.577	0.23	0.271
0.376	0.057	0.532	0.764	0.749	0.922	0.274	0.775	0.971	0.418	0.437	0.049	0.934	0.352	0.537	0.451	0.92	0.45	0.667	0.965	0.796
0.193	0.54	0.542	0.736	0.166	0.549	0.838	0.984	0.334	0.9	0.879	0.089	0.305	0.099	0.14	0.123	0.679	0.514	0.369	0.396	0.931
0.03	0.895	0.993	0.351	0.106	0.54	0.856	0.285	0.922	0.669	0.796	0.042	0.633	0.932	0.603	0.925	0.173	0.523	0.072	0.668	0.548
0.786	0.093	0.966	0.706	0.46	0.851	0.256	0.118	0.375	0.594	0.8	0.022	0.274	0.222	0.857	0.028	0.068	0.631	0.813	0.123	0.145
0.818	0.772	0.551	0.631	0.566	0.858	0.71	0.358	0.516	0.895	0.751	0.19	0.868	0.959	0.375	0.88	0.168	0.16	0.865	0.749	0.892
0.594	0.292	0.96	0.189	0.234	0.505	0.528	0.832	0.944	0.071	0.692	0.861	0.401	0.604	0.439	0.191	0.838	0.525	0.262	0.659	0.022
0.837	0.675	0.553	0.92	0.957	0.819	0.3	0.796	0.627	0.222	0.826	0.047	0.896	0.008	0.07	0.4	0.426	0.465	0.326	0.44	0.777
0.74	0.366	0.059	0.552	0.117	0.984	0.313	0.041	0.39	0.331	0.996	0.551	0.527	0.259	0.143	0.326	0.159	0.371	0.002	0.286	0.643
0.249	0.254	0.817	0.675	0.684	0.298	0.645	0.007	0.4	0.341	0.494	0.126	0.284	0.926	0.626	0.226	0.413	0.538	0.176	0.106	0.498
0.651	0.987	0.242	0.5	0.436	0.323	0.44	0.821	0.625	0.367	0.432	0.822	0.771	0.796	0.032	0.217	0.139	0.283	0.05	0.253	0.046
0.69	0.059	0.279	0.058	0.217	0.426	0.413	0.545	0.818	0.898	0.689	0.457	0.37	0.431	0.626	0.852	0.621	0.714	0.919	0.907	0.085
0.782	0.257	0.753	0.198	0.131	0.033	0.431	0.742	0.042	0.8	0.256	0.796	0.804	0.505	0.205	0.955	0.252	0.459	0.42	0.797	0.864
0.026	0.272	0.479	0.447	0.696	0.707	0.112	0.47	0.622	0.66	0.82	0.485	0.605	0.377	0.352	0.916	0.442	0.64	0.891	0.901	0.258
0.893	0.382	0.322	0.179	0.356	0.425	0.967	0.255	0.165	0.243	0.648	0.804	0.507	0.281	0.213	0.615	0.598	0.883	0.708	0.082	0.089
0.235	0.48	0.118	0.936	0.335	0.537	0.988	0.815	0.32	0.641	0.64	0.528	0.258	0.247	0.333	0.75	0.563	0.726	0.053	0.677	0.243
0.51	0.548	0.606	0.204	0.326	0.899	0.424	0.312	0.956	0.304	0.664	0.053	0.581	0.887	0.908	0.543	0.786	0.521	0.086	0.891	0.553
0.521	0.864	0.006	0.775	0.933	0.175	0.169	0.853	0.971	0.793	0.547	0.257	0.146	0.217	0.543	0.297	0.446	0.668	0.969	0.119	0.086
0.268	0.455	0.779	0.184	0.945	0.975	0.396	0.29	0.548	0.812	0.174	0.488	0.59	0.2	0.633	0.463	0.969	0.504	0.962	0.835	0.828
0.569	0.184	0.439	0.18	0.235	0.3	0.564	0.573	0.53	0.173	0.821	0.436	0.087	0.771	0.186	0.943	0.802	0.901	0.555	0.419	0.821
0.033	0.519	0.593	0.154	0.137	0.296	0.237	0.862	0.449	0.431	0.575	0.494	0.128	0.503	0.505	0.122	0.752	0.164	0.916	0.308	0.249
0.572	0.079	0.002	0.201	0.87	0.013	0.595	0.608	0.398	0.818	0.261	0.941	0.295	0.331	0.994	0.865	0.044	0.182	0.828	0.819	0.784
0.985	0.94	0.021	0.689	0.537	0.896	0.031	0.173	0.465	0.031	0.04	0.714	0.227	0.841	0.719	0.967	0.43	0.67	0.143	0.236	0.089
0.069	0.724	0.719	0.809	0.251	0.382	0.972	0.79	0.245	0.742	0.605	0.358	0.93	0.721	0.622	0.155	0.978	0.991	0.868	0.044	0.917
0.557	0.717	0.452	0.828	0.693	0.058	0.235	0.459	0.017	0.833	0.498	0.637	0.322	0.044	0.105	0.349	0.867	0.004	0.775	0.667	0.214
0.728	0.017	0.484	0.458	0.229	0.719	0.082	0.229	0.833	0.199	0.152	0.125	0.097	0.173	0.909	0.844	0.421	0.227	0.73	0.946	0.833

Exhibit 4
Sample Numbering

Sample numbering can be in any format and method specified in the work plan or by the PHP as long as it ensures that there are unique location and sample numbers for all locations at which survey data is taken and all samples. If not designated in any other manner the following sample number protocol should be followed.

BD-RM-UFS-GD-x-y-z-ddmmyy

Where:

- BD is the building designation,
- RM is the room designation,
- UFS is the unfolded rooms surface designation from the Sampling/Survey Grid Datasheet's graphical description.
- GD is the sampling location grid designator.
- x-y-z is the coordinates within the grid (may be eliminated if they same coordinates are used for all grids), the z value should be proceed by an "a" if the value is the distance out of the surface rather than into the surface.
- date of the sample collection if more than one sample is taken otherwise not necessary.

Table of Contents

1.0 PURPOSE

This procedure provides the requirements for measuring direct beta surface activity using a ratemeter or scalar with a Gieger-Mueller (GM) pancake probe (i.e., mica window) detector. The purpose of this procedure is to institute daily operational checks and to standardize the operation of the beta/photon survey instrument to ensure that quality field measurements are obtained.

2.0 SCOPE

This instrument will be used to quantify radiological contamination (beta/photon-emitting radioisotopes) that may be present on the surfaces of floors, walls, soils, or equipment. These direct surface measurements are taken prior to collecting a smear sample to be representative of total (e.g., fixed plus removable) contamination levels. This instrument is also used to screen samples (e.g., smears, soils, etc.) to determine if radiological contamination is present.

This procedure is applicable to the collection of beta/photon emission data, unrelated to energy of the emission, within the limitations of the response of the detector. This equipment maybe used to support decommissioning and/or impact assessment data collection under the requirements of the DOE, NRC, or EPA. This procedure maybe applied to other activities at the discretion of the Project Manager. This procedure can only be implemented by trained and qualified personnel.

3.0 REFERENCES

1. NRC, 1997. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Final, December 1997.

2. *Instruction Manual Ludlum Model 12 Count Ratemeter,* October 1990.

3. *Instruction Manual Ludlum Model 44-9 Alpha, Beta, Gamma Detector*, June 1995.

4. SOP-R-SUR-004, *Collection, Handling, and Analysis of General Smear Samples for Environmental Investigations,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

5. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, *Quality Assurance Manual,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

4.0 DEFINITIONS

1. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.
   - The materials associated with the radiation source and any associated container including back-scatter surfaces.

2. **GM (Geiger-Muller) detector** is a sealed gas filled detector with associated electrodes that produces an avalanche type pulse whenever the gas is ionized, typically by the absorption of a charged particle. The pulse characteristic is independent of the energy of the radiation, if the energy is sufficient to pass through the detector wall (e.g., window on pancake probe) and cause ionization of the gas.

3. **Ludlum Model 12 ratemeter with a 44-9 detector** is an instrument used to detect the presence of beta and gamma radiation on surfaces and assess the flux measured, which can be used to extrapolate the activity on the surface.

4. **Ratemeter** is an electronic device that sums pulses received from a detector over a set time period (typically very short) and displays this count in the form of equivalent counts per minute (cpm).

5. **Scalar** is similar to a ratemeter but this instrument counts the pulse for a time period, typically set by the operator, and displays the total counts for this time period.

6. **Survey Area** is an area where radioactive materials or contamination are or may be present. Survey areas include areas where samples/smears (which may contain radioactivity) are being screened.

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

1. Use a Ludlum Model 12 ratemeter with a 44-9 detector or an equivalent instrument system specifically authorized by the PHP.

2. The survey requirement will be established by the work plan, safety plan, and/or equivalent documents for the project or specifically provided by the PHP.

3. Only qualified and trained personnel are allowed to implement this procedure.

4. A background determination and instrument operational check in accordance with this procedure shall be performed prior to the first use of the instrument on each shift.

5. The instrument shall be fully functional prior to using in the survey area.

6. If the instrument appears to have failed during use in the survey area, then leave the survey area immediately.

7. **NEVER ADJUST THE CALIBRATION CONTROLS.**

8. Take care not to puncture the thin mica window of the detector, especially when working outdoors in vegetated areas or surfaces with protrusions.

9. The count ratemeter, cable, and detector are calibrated as a unit and may not be interchanged without recalibration.

6.0 RESPONSIBILITIES

6.1 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the selection and survey requirements are consistent with the technical requirements of this procedure, the regulations, applicable project documentation, and good health physics practices.

2. Training the Radiological Control Technician (RCT) in the proper use of this procedure.

3. Providing independent review of the documentation and data to ensure it is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

4. Ensuring that the instruments are properly maintained and calibrated at specified intervals.

5. Training the RCTs in the proper use of this instrument.

6. Identification and specification of equivalent instrumentation to be used with this procedure.

7. Reviewing the instrument field test and measurement data to ensure that the data is consistent and credible, and following up on data anomalies.

6.2 Radiological Control Technicians (RCT) are responsible for:

1. Implementing this procedure and the applicable training.

2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

3. Reporting out of specification conditions to the Project Health Physicist and/or Field Supervisor.

4. Operating this instrument in accordance with this procedure and the applicable training.

5. Maintaining daily operational check records for each instrument.

6. Documenting data collected using the instrument in accordance with appropriate regulations and procedures.

7. Reporting instrument malfunctions to the Project Health Physicist.

6.3 Project Manager (PM) (or designee. such as the field supervisor)

1. Provides required materials and trained/qualified personnel for implementation of the task.

2. Provides operational review of the project specific activities for these data collection activities.

3. Determines the applicability of this procedure beyond the areas specifically identified in Section 2.0.

6.4 Field Supervisor (FS)

1. PM site representative and responsible for routine supervision of the task.

2. Verifies completion of the task.

7.0 PROCEDURES

Note: When surveying, the detection of increased activity can be more effectively identified by the audible sound than by monitoring the meter movement or digital display. Use the sound to locate the activity and the meter or display to assess the count rate or counts.

Note: This instrument typically has the following specifications:

- The detector is a pancake-type, halogen-quenched G-M.
- The mica window has a surface density of 1.7 ± 0.3 mg/cm^2 and is protected by a 79% open stainless steel screen. The window has an active area of 15 cm^2 and an open area of 12 cm^2.
- The typical (2π geometry) efficiencies of the detector are C-14 10%; Sr/Y-90 45%; Tc-99 38%; P-32 64%; and Pu-239 30%.
- The meter range is 0 to 500 counts per minute (cpm) with multiplier settings of X1, X10, X100, and X1000 for an overall range of 0 to 500k cpm.
- The meter is powered by batteries an in-use life of at least one shift.

Note: If at anytime during this procedure there are conditions that may impact the results, note this information in the comment section or on the back of the applicable datasheet.

Note: Radioactive decay is a statistical phenomena and at low count rates the radiation emission rate will fluctuate significantly. In estimating count rates, the central tendency of the count rate (e.g., meter position) and not the upper or lower bound is relevant. It addition, in addressing survey activities, the background radiation from natural and unrelated man-enhanced radiation (e.g., fallout, some welding rods, exit signs, smoke detectors) typically changes significantly as a function of location due to changes in materials present. It is important to recognize that soils, rocks, concrete, blocks, and ceramics typically have significant levels of ambient background associated with them and care should be exercised to not miss-identify these materials as contaminated when only ambient background is present.

Note: This procedure is for using the Ludlum Model 12 ratemeter with a Ludlum Model 44-9 detector. Equivalent substitutions may be used, per authorization of the PHP.

CAUTION: When approaching unknown conditions be sure that the detector is on the highest scale and then reduce it to the appropriate scale once conditions are established. Extremely high radiation fluxes can result in saturation of this instrument and the reads dropping to zero. If the GM ratemeter/scalar fails to indicate the presence of normal ambient background leave the area immediately unless conditions can be established by other instrumentation. The absence of a background reading and audible counting (unless the speaker is turned off) is an indication of instrument malfunction.

Note: If this activity involves a trainee then both the trainee and the RCT performing the on-the-job training print/initial/sign their names.

Note: It is acceptable to add attachments containing the information to the Daily Operational Check Log (Exhibit 1) and then reference this attachment (i.e., attachments are not included in the datasheet page count but are numbered separately) on the datasheet. In addition the Daily Operational Check Log maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

1.	PHP	Reviews the work plan, site data, regulatory requirements, customer requirements, and other applicable documentation with the PM and establishes the appropriate survey requirements, equivalent instrumentation, count times, and action levels for implementing this procedure.
2.	FS/ PHP	Directs initiation of the survey activity in accordance with this procedure.
3.	PHP	Provide the RCT with the data identified in step 1.
4.	RCT	Ensure that meter and detector match the calibration certificate prior to operating. • Assign an unique meter number to the instrument, which does not have one. • Attach an identifying label to the side of the meter, which does not have one. • Record the meter number, meter and detector serial numbers, and calibration information on the Survey Instrument Log.
5.	RCT	Record the following information on the Daily Operational Check Log (Exhibit 1) prior to using the instrument. A separate log needs to be maintained for each instrument used. • Project Title and Number, • Meter Make/Model and Serial Number, • Detector Make/Model and Serial Number, • Last Date Calibrated, • Calibration Due Date, • Applicable units for background and source counts (typically cpm, counts, or ⊠rad/hr), • Applicable count time if scalar counts are made or an R for ratemeter readings, and • Isotope-specific instrument efficiencies based on current calibration.
6.	RCT	If the meter or detector is due for calibration, it must be tagged "Calibration Due" and given to the Project Health Physicist (or Field Supervisor if Project HP is unavailable). Instruments requiring calibration shall not be used for taking radiation measurements in survey areas.
7.	RCT	Check the high voltage setting and ensure that it is set as recommended on the appropriate meter calibration certificate. If the voltage is not properly set, contact the Project Health Physicist for further direction.
8.	RCT	Document these activities on the operational Daily Operational Check Log.

9. RCT Records the Background and Source Check count time for "Scalar" mode on the datasheet. If the instrument has no scalar mode record an "R" on the count time line.

10. PHP Review the datasheet routinely and once it is completed per Section 7.9, and once any data anomalies have been resolved, sign and date the datasheet, then store this record in accordance with applicable Parsons and project procedures and client requirements.

11. General The data on the datasheet should not be released to the client until Step 10 has been completed.

7.2 Operational Checks

Note: This section of the procedure maybe implemented in conjunction with the sampling/survey activity. It is acceptable to add attachments containing the information to the Sampling/Survey Grid Datasheet and then reference this attachment on the datasheet. Any attachments are separately numbered and not part of the Datasheet page numbering.

1. RCT **Visual Inspection of Instrument--** Each instrument shall be inspected at the start of each work shift to identify potential problems or damage prior to being used in the survey area.

2. RCT **Visual Inspection of Instrument--** The date and time of this check and the name of the person performing the check shall be recorded on the Daily Operational Check Log (Exhibit 1) that corresponds to the meter/detector serial numbers in conjunction with documentation of the other activities in this section.

3. RCT **Visual Inspection of Instrument--** Visually check the instrument for signs of physical damage (e.g., broken or loose cables; missing screws or other parts; and inoperable switches or knobs) and ensure that the calibration due date has not passed.

4. RCT **Visual Inspection of Instrument--** Report any damage or other problems (not already documented on the log) to the Project Health Physicist to determine if the equipment can still be used. Malfunctioning instruments are not to be used in the survey area, without specific authorization of the Project Health Physicist.

5. PHP **Visual Inspection of Instrument—**Assesses the significance of the damage and based on good health physics practices determines if the instrument should not be used. Also provides information based on this determination to the RCT to be recorded in the "Remarks" section.

6. RCT **Visual Inspection of Instrument**—If the instrument is damaged and should not be used (i..e., based on discussion with the {PHP) indicate "N" in the Visual/Battery Check portion of the log and terminate this procedure. Document the damage in the "Remarks" section.

7. RCT **Battery Check--** The batteries in each meter shall be checked at the start of each work shift to ensure proper operation prior to being used in the survey area.

Turn the meter on and allow several minutes for the instrument to "warm-up" and stabilize.

8. RCT **Battery Check--** Test the batteries to ensure that the unit is functional by turning the dial to the "BAT" position. The battery strength is indicated by the needle deflection.

9. RCT **Battery Check--** If the meter reading indicates that the batteries are good (e.g., needle deflection into the "BAT TEST" portion of the scale), enter "OK" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column.

10. RCT **Battery Check--** If the batteries are weak, turn off the meter and replace the weak batteries with new batteries. Recheck the meter in accordance with Steps 7 through 10 to ensure that the new batteries are good. If the meter indicates that the batteries are good, enter "Replaced" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column to indicate that the batteries were replaced.

11. RCT **Battery Check--** If the meter indicates that the new batteries are not good, replace the batteries again and retest the meter. If the meter is still not functioning properly after trying two new sets of batteries, take the meter out of service and contact the Project Health Physicist. Enter "F" (Failed) on the Daily Operational Check Log (Exhibit 1) under the "Battery Check" column to indicate that the meter was taken out of service.

12. RCT Continue Procedure in Section 7.3, Background Check.

7.3 Background Check

1. RCT After completing the visual inspection and battery check (see Section 7.2), a background check shall be performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift background check should be completed.

2. RCT Background readings shall be measured in a low background area to verify proper instrument operation by measuring a consistent background radiation level, and to ensure that the detector is not contaminated. When practicable, the background area selected shall be similar to the conditions encountered in each survey area. Obtain the source count jig.

3. RCT All background checks shall be conducted at the same location and in the source count jig to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials outside of the survey area, such as smears and air samples (as discussed in Section 7.7).

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.

- The "F-S" toggle switch to the slow response "S" mode.
- Press the speaker button "ON", if applicable.

5. RCT The detector face is to be orientated in the source count jig with the face down, consistent with Section 7.4. Ensure that all radiation sources are removed (at least 10 feet away) from the area during the background check.

6. RCT If a ratemeter background is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

7. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column and go to step 10.

8. RCT If the scalar mode data is to be collected (i.e., a count time is specified), set the meter to scalar count time and the counting time to the value on the Daily Operational Check Log and initiate the scalar count.

9. RCT Record the reading in cpm or count on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column.

10. RCT Enter the background data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The background data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

11. RCT If this background data exceeds the allowed variation from the mean (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicates the instrument is beyond the acceptable tolerance for variability.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

12. RCT If the background reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 background values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of background through time, thus collection of several data point in a short time span does not provide useful data since the background is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

13. RCT If the background exceeds 2 standard deviations repeat steps 6 to 13 once, contact the PHP for instructions if the excess deviation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations criteria from step 12, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column. Also indicate the type of action (i.e., decontamination) that was taken for the recheck measurement.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

14. RCT If a source check is required proceed to Section 7.4.

15. RCT If a source check is not required complete return to the applicable section of this procedure.

7.4 Source Check

1. RCT After completing the background check (see Section 7.3), a source check is typically performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift source check should be completed. Obtain the source jig if it is not present from Section 7.3 activities.

2. RCT Source readings shall be measured in a low background area in the source jig to verify proper instrument operation by measuring a consistent source plus background radiation level, and to ensure that the detector is not contaminated.

3. RCT When practicable source checks shall be conducted at the same location to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials, such as smears and air samples, outside of the survey area (as discussed in Section 7.7).

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

-
- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.
- The "F-S" toggle switch to the slow response "S" mode.
- Press the speaker button "ON".

5. RCT Obtain the check source(s) for this instrument. Use the source #(s) on the Daily Operational Check Log, if the data is unavailable use the source(s) designated by the PHP.

6. RCT Carefully place the source in the jig facing up.

CAUTION: *Do not contact the active surface of the sources* with your skin. This can result in unnecessary radiation exposure. These contact doses are typically significantly higher than generally expected by personnel. In addition, the chemical on the skin surface may damage the source invalidating its calibration and possibly causing the release of radioactive contamination.

7. RCT Orient the detector face so it is facing the source at the fixed distance and in the fixed orientation established by the jig. Ensure that all other radiation sources are removed (at least 10 feet away) from the area during the source check.

8. RCT If a ratemeter source check is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

9. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column, then go to step 12.

10. RCT If the scalar mode data is to be collected (i.e., a count time is specified), set the meter to scalar count time and the counting time to the value on the Daily Operational Check Log and initiate the scalar count.

11. RCT Record the reading in counts or cpm on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column.

12. RCT Enter the source check data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The source check data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

13. RCT If the source check data exceeds the allowed variation from the mean calculated in the control chart activities (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicate the instrument is beyond the acceptable tolerance for variability.

14. RCT If the source check reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 source check values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of the instrument performance through time, thus collection of several data point in a short time span does not provide useful data since the instrument performance is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

15. RCT If the source check value exceeds 2 standard deviations repeat steps 7 to 15 once, contact the PHP for instructions if this excess variation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations of the average for the control readings, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

16. RCT Describe any off-normal conditions that occurred during this process (this includes Sections 7.3 to 7.4 activities) in the "Remarks Column" and then initial entry.

17. RCT Return the source to the appropriate storage area.

18. RCT Record the data , time, and initial the entry, then submit the datasheet to the FS.

19. FS Verify activity completion and initials after the RCT.

20. RCT Proceed to the applicable section for completion of data collection activities. At the termination of an activity or withdrawal of an instrument from usage arrange for transmission of the Daily Operational Check Log to the PHP for action and maintain a copy of this log in a manner consistent with the applicable Parsons/project records management procedure.

21. PHP Review the datasheet per Section 7.9, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

22. General The data on the datasheet should not be release to the client until Step 21 has been completed.

7.5 Survey of Surfaces or Items

Note: This instrument will be used to determine if radiological contamination (beta/photon-emitting radioisotopes) are present on the **surfaces** of floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: The efficiency of this instrument for detection of beta activity is typically substantially greater than that for photons.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

CAUTION: This instrument is not effective for the detection of tritium (i.e., H-3) beta emissions.

1. RCT Verify that Sections 7.3 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "N" to indicate that is a static count,
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and
- The count time indicated as "R".

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check source to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operation per Sections 7.3 to 7.4.

6. RCT Position the "F-S" toggle switch to the **"F" (fast)** mode and ensure the speaker is on.

7. RCT Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

8. RCT Scan at a rate of 1 inch every 2 seconds to give the instrument time to respond. Scan rates greater than two inches per second drastically reduce the probability of detection. The operator should listen to the audio output closely since it responds faster than the meter reading.

9. RCT For a ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

10. RCT If the reading exceeds 100,000 dpm/100 cm^2 (1,670 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required. [Using an instrument efficiency of 30% for beta particle detection and detector area of 15 cm^2, a reading greater than 4,500 cpm exceeds the action level.]

11. RCT When surveying, any response above background should be investigated by holding the detector still to verify that the radiation rate is above background.

12. RCT If a reading above twice background or the action level provided by the PHP for this survey is confirmed, a static measurement should be taken in accordance with Section 7.6 of this procedure.

13. RCT Continue scanning the entire surface within the designated area.

14. RCT If localized contamination is found the RCT may, decontaminate the surface per applicable Parsons procedure or other instructions provided by the Project Health Physicist.

15. RCT Resurvey the decontaminated areas per Steps 7 through 15.

16. RCT Record the scanning (i.e., highest reading in the area after any localized decontamination) and decontamination information on the Surface Radiation Field Measurement Data Sheet (see Exhibit 3).

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

17. RCT Repeat Steps 8 through 17 for each surface measurement location.

18. RCT Per direction of the PHP/FS or at the RCT discretion complete Sections 7.3 and/or 7.4 to re-verify instrument performance. This is often completed whenever there is a break in work activities.

19. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

20. FS Review and if completed properly, sign and date the datasheet, then store this in-process record in accordance with applicable Parsons and project procedures and client requirements.

21. PHP Review the datasheet per Section 7.9, and once any data anomalies have been resolved, sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

22. General The data on the datasheet should not be release to the client until Step 21 has been completed.

7.6 Field Static Counts

Note: This instrument will be used to determine if radiological contamination (beta/photon-emitting radioisotopes) are present on the **surfaces** of floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: The efficiency of this instrument for detection of beta activity is typically substantially greater than that for photons.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

CAUTION: This instrument is not effective for the detection of tritium (i.e., H-3) beta emissions.

1. RCT Verify that Sections 7.3 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "Y" or "N" to indicate if this is a static count,
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and

The count time in minutes, indicate "R" in this space if the survey is being made in ratemeter mode.

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.3 to 7.4.

6. RCT Position the "F-S" toggle switch to the **"F" (fast)** mode and ensure the speaker is on.

7. RCT Per direction of the PHP/FS or at the RCT discretion complete Sections 7.3 and/or 7.4 to re-verify instrument performance. This is often completed whenever there is a break in work activities.

8. RCT Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

9. RCT If this is a scalar mode measurement initiate a scalar count or if a ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

10. RCT If the reading exceeds 100,000 dpm/100 cm^2 (1,670 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required. [Using an instrument efficiency of 30% for beta particle detection and detector area of 15 cm^2, a reading greater than 4,500 cpm exceeds the action level.]

11. RCT Record the surface reading in cpm on the Surface Radiation Field Measurement Data Sheet (Exhibit 3). The location of the measurement is also to be recorded on the Data Sheet.

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

12. RCT Repeat Steps 8 through 12 for each location.

13. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

14. FS Review and if completed properly, sign and date the datasheet, then stores this in-process record in accordance with applicable Parsons and project procedures and client requirements.

15. PHP Review the datasheet per Section 7.9, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

16. General The data on the datasheet should not be release to the client until Step 15 has been completed.

7.7 Counting of Smear, Air Samples, and Other Materials

CAUTION: Smears, samples, and equipment should be handled as potentially contaminated material during this process.

Note: If shield sources, sources, or smears are used in this process these maybe completed integral to the unshielded counting process to minimize the handling of the radioactive or potentially radioactive materials.

1.	PHP	Specify the appropriate counting system geometry and sources for used in calibrating/source checking this configuration and provide this information to the RCT.
2.	RCT	Obtains the counting jig/configuration system and sources specified by the PHP.
3.	RCT	Verify that Sections 7.3 through 7.4 have been completed for the instrument.
4.	RCT	Complete a background count for the counting jig/configuration per Section 7.3, being sure to use the control charts and actions level for this specific geometry for the instrument and not the general geometry for the instrument.
5.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the Surface Radiation Field Measurement Datasheet" used to record this data, which is a possible reference.)
6.	RCT	Complete a source count for each source designated by the PHP for the counting jig/configuration per Section 7.4, being sure to use the control chart and action level for this specific geometry for the instrument and not the general geometry for the instrument.
7.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the "Surface Radiation Field Measurement Datasheet" used to record this data, which is a possible reference.)
8.	RCT	If the PHP indicates that partially shield sources will also be used in this evaluation, repeat steps 6 and 7 with these shielded sources indicating the source and the shield(s) provided in the "Source #" column.
9.	RCT	Return the source to the appropriate storage area.
10.	RCT	Place the sample in a jig or other container to establish the fixed geometry specified by the PHP
11.	RCT	Perform the static count of the samples in accordance with Section 7.6 in a low background area. The sample number and any associated shield used in the count are the location. The samples are to be counted in the jig.
12.	RCT	If the PHP indicates that a sample(s) should be counted in a shield geometry as well as without the shield, the process described in steps 10 through 12 should be completed with the shield samples as well and the shield number added to the sample location description as well.

7.7 Counting of Smear, Air Samples, and Other Materials

CAUTION: Smears, samples, and equipment should be handled as potentially contaminated material during this process.

Note: If shield sources, sources, or smears are used in this process these maybe completed integral to the unshielded counting process to minimize the handling of the radioactive or potentially radioactive materials.

1.	PHP	Specify the appropriate counting system geometry and sources for used in calibrating/source checking this configuration and provide this information to the RCT.
2.	RCT	Obtains the counting jig/configuration system and sources specified by the PHP.
3.	RCT	Verify that Sections 7.3 through 7.4 have been completed for the instrument.
4.	RCT	Complete a background count for the counting jig/configuration per Section 7.3, being sure to use the control charts and actions level for this specific geometry for the instrument and not the general geometry for the instrument.
5.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the Surface Radiation Field Measurement Datasheet" used to record this data, which is a possible reference.)
6.	RCT	Complete a source count for each source designated by the PHP for the counting jig/configuration per Section 7.4, being sure to use the control chart and action level for this specific geometry for the instrument and not the general geometry for the instrument.
7.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the "Surface Radiation Field Measurement Datasheet" used to record this data, which is a possible reference.)
8.	RCT	If the PHP indicates that partially shield sources will also be used in this evaluation, repeat steps 6 and 7 with these shielded sources indicating the source and the shield(s) provided in the "Source #" column.
9.	RCT	Return the source to the appropriate storage area.
10.	RCT	Place the sample in a jig or other container to establish the fixed geometry specified by the PHP
11.	RCT	Perform the static count of the samples in accordance with Section 7.6 in a low background area. The sample number and any associated shield used in the count are the location. The samples are to be counted in the jig.
12.	RCT	If the PHP indicates that a sample(s) should be counted in a shield geometry as well as without the shield, the process described in steps 10 through 12 should be completed with the shield samples as well and the shield number added to the sample location description as well.

13. RCT Document the geometry for these counts including any shielding used in the "Specific Geometry" section of the Surface Radiation Field Measurement Datasheet.

14. RCT Samples should be handled as potentially contaminated material after counting.

7.8 Personnel Surveys

Note: This instrument will be used to determine if radiological contamination (beta/photon-emitting radioisotopes) are present.

Note: The efficiency of this instrument for detection of beta activity is typically substantially greater than that for photons.

CAUTION: This instrument is not effective for the detection of tritium (i.e., H-3) beta emissions.

1. RCT Verify that Sections 7.3 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Ensure that the instrument is on and properly "warmed-up".

3. RCT Set the instrument to the lowest scale consistent with the ambient background, if required.

4. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check source to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.3 to 7.4.

5. RCT Position the "F-S" toggle switch to the **"F" (fast)** mode and ensure the speaker is on.

6. RCT Hold the detector face within 0.25 inches of the surface being measured.

7. RCT Scan at a rate of 1 inch every 2 seconds to give the instrument time to respond. Scan rates greater than two inches per second drastically reduce the probability of detection. The operator should listen to the audio output closely since it responds faster than the meter reading.

8. RCT If an apparent reading above background is detected allow the ratemeter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

Note: Survey activities should be particularly thorough for areas that routinely come in contact with potentially contaminated surfaces (e.g., hand and feet).

9. RCT If radioactivity is present in excess of the action levels in the safety plan or equivalent documentation, identify the area and document the activity on a personnel contamination datasheet, when time is available.

10. RCT **CAUTION: Overly aggressive decontamination may result in breaching the skin surface, resulting in the introduction of the radioactive material into the body (i.e., the injection pathway) and results in substantial increase in personnel dose. Any action with the potential to seriously injury the individual or lead to introduction of radioactive into the body should only be undertaken under the direction of a physician. Decontamination of wounds, aside from flushing with soap & water or wound disinfectants should be completed only under the direction of a physician.**

Decontaminate surface or remove and dispose of contaminated protective or other clothing. Decontamination shall be handled in a manner consistent with the applicable health and safety plan.

11. RCT/ FS/HP **CAUTION: Documentation of the contamination data should not be allowed to interfere with the timely decontamination of the individual.**

CAUTION: This Personnel Contamination Datasheet is Privacy Act data and shall be handled as such. This data is NOT a project record and the management of this record is addressed by the Parsons Health and Safety Program.

If contamination was detected document the following data on the pre and post decontamination conditions on the Personnel Contamination Datasheet:

- Person's full name,
- Person's employer,
- Person's employee number, addresses, and assigned permanent work location,
- A detailed drawing of the location of the contamination,
- The activity distribution in the contaminated area(s),
- The projected radionuclides that are potentially present in the area,
- The lapse time from when the individual might have become contaminated (i.e., typically when the individual entered the contaminated area) until the contamination was removed or reduced,

- The time any identified residual activity remained on the individual,
- The instrument (include both meter and detector) manufacturer, model, and serial number used in the survey,
- Copy of the calibration certificate for the detector,
- Description of any decontamination activity and associated actions,
- Name of the name, employer, employee number, address, and assigned permanent work location of the:
  - Health and Safety Officer,
  - Field Supervisor, and
  - Health Physicists involved,.
- Surveyor, site Health Physicist (if any), and Field Supervisor print their names and then sign and date the form.

12. FS Submit the Personnel Contamination Datasheet to a professional health physicist (preferably a Certified Health Physicist) who will review the data and assess the dose.

13. HP Assess the localized radiation dose associated with this exposure consistent with:

- 10 CFR 20 and/or 10 CFR 835, as applicable,
- ICRP and NCRP guidance, and
- good health physics practices.

14. HP Document the assessment on the Personnel Contamination Datasheet, including the verification and validation of any software used. If this assessment of dose involves a dose calculation the calculation must meet the applicable Parson's calculation procedure.

15. HP Print name and title, sign, and date the data sheet.

16. HP Transmit a copy of the completed form to the responsible health and safety officer and archive the original consistent with Parsons Health and Safety Program.

17. Health & Safety Officer Provide a copy of the Personnel Contamination Datasheet to the individual and brief the individual on the associated risks and provide the contact information for the HP who completed the dose assessment.

18. HP Provide follow-up assistance and information to the employee and the Health and Safety Officer.

7.9 Data Verification

This is the initial step in the verification and validation of the data generated by this procedure, the final steps will be addressed by the verification and validation process describe in the applicable workplan or similar document.

1. HP On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibit 1) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).

2. HP Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.

3. HP Review the data for the following technical considerations:

- Are the data technically consistent,
- Are the calibrations of the instrument current, valid for the intended use, and of sufficient accuracy for the intended use,
- Were appropriate and current calibration and check sources used,
- Is there appropriate documentation for all calibrations (e.g., meters, detectors, and sources) in the records,
- Are the background values credible and are the background data consistent with the statistical variability expected,
- Are the expected progeny present and in the appropriate ratios based on relative activities,
- Is the expected level of background radiation present,
- Have appropriate backgrounds data set been obtained,
- Is there consistency between these values and the other survey data,
- Are the radiation types and radionuclides present in credible relative ratios,
- Is additional count time required to meet data quality objectives,
- Does the equipment appear to be functioning properly,
- Were any technical concerns/inconsistencies appropriately followed up on and resolved, and
- Are there any other outstanding technical, operational, or quality issues associated with the data.

4. HP If there are problems or potential problems associated the data, the HP initiates the any designated SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.

5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.

6. HP Document the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification.

7. HP Once the datasheet is completed and any applicable NCRs are generated, sign and date the Datasheets as verified (i.e., verified pending resolution of outstanding NCRs) and store the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure.

8.0 RECORDS

Exhibits 1 and 3 and any associated attachments and any applicable associated NCRs are the quality records generated by this procedure. Exhibit 4 is not project related and not managed under the project QA system. It is a Parson's record and will be managed in a manner consistent the applicable office and Parson Health and Safety Program.

Exhibit 1

PARSONS

Daily Operational Check Log
Instrument #____________

SOP-R.SUR-1-1 -__________ Page ___ of ___
Revision 0
Last Date Calibrated: __________
Calibration Due Date: __________

Project Title: ____________________
Project Number: ____________________
Prepared By Print: ____________________
Prepared By Signature: ____________ Date: ______
Verified By Signature: ____________ Date: ______

Meter Make/Model: ____________
Meter Serial No.: ____________
Detector Make/Model: ____________
Detector Serial No.: ____________

(optional data enter as needed)
Isotope: ______ Efficiency: ______
Isotope: ______ Efficiency: ______
Isotope: ______ Efficiency: ______
Isotope: ______ Efficiency: ______
Channel 1 Window: ______ to ______ (keV)
Channel 2 Window: ______ to ______ (keV)

Voltage Consistent With Calibration Certificate			No	Acceptable Background Range		Acceptable Source Check Range	

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (___-minute Scalar)	Source #	Pass/ Fail		

Exhibit 1 (Continued)

PARSONS

Daily Operational Check Log (Continuation Sheet)
Instrument #____________

SOP-R.SUR-1-1 -____________ Page ___ of ___
Revision 0

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___) (___-minute Scalar)	Pass/ Fail	Gross Reading (___) (___-minute Scalar)	Source #	Pass/ Fail		

Exhibit 2
Example of a Control Chart

Parameter Being Tracked	Cs-137 0.661 MeV peak counts, post fine tuning
	Electectronics
Instrument Type	URSA-MCA
Model Number	Universal Radiation Spectrum Analyzer
Manufacturer	RSA
Serial Number	20291
	Detector
Instrument Type	Fidler
Model Number	M-23
Manufacturer	Ortec
Serial Number	X-111
Geometry	Center Line Area Source at 4"
ROI	Cs-137 0.661 MeV peak
	Count Data
	Mean= 897.1667
	STDEV= 71.46025

Date/Time	Data Number	Data	Pull Block	Status
1/1/00 0:00	1	905	[redacted]	[redacted]
1/5/00 0:00	3	1001	[redacted]	[redacted]
1/6/00 0:00	4	787	[redacted]	[redacted]
1/7/00 0:00	5	923	[redacted]	[redacted]
1/10/00 0:00	6	911	[redacted]	OK
1/2/00 0:00	2	856	[redacted]	[redacted]

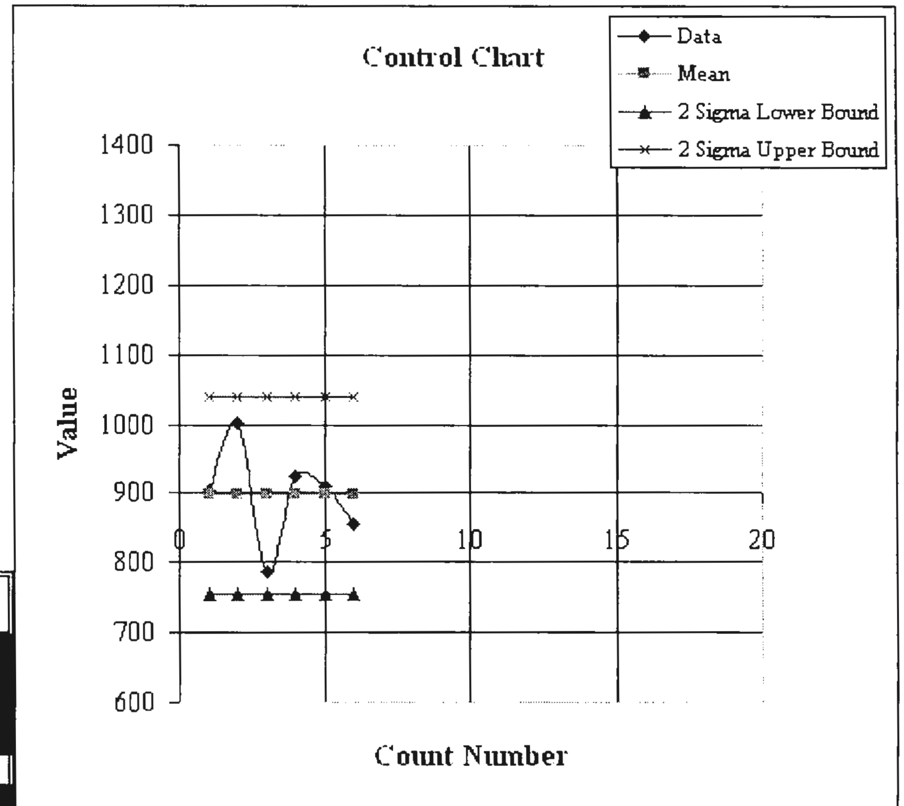


Exhibit 3

PARSONS

Surface Radiation
Field Measurement Datasheet

SOP-R-SUR-1-2- ________________ Revision 0
Page ___ of ___ Date: ______________

Project Title: ______________________________
Surveyor (print):_______________ Surveyor Signature:_______________ Date: _____

Project Number: ______________________________
Verifier (print): _______________ Verifier Signature: _______________ Date: _____

Building/area/Floor: ______________________________
Room/Unit Designation: ______________________________
Complete FS (print):_______________ FS Signature: _______________ Date: _____

Measurement Location		Direct Surface Reading static Y/N Type _______ Count Time (M) _____			Direct Surface Reading static (Y/N) Type _______ Count Time (M) _____			Alt. Distance (optional) _______cm (left instr) Alt. Distance (optional) _______cm (right instr)
No	Per Reference Map	Value (_______)	Channel (optional)	Instr. #	Value (_____)	Channel (optional)	Instr. #	Remarks
Instr. Check Source								
Specialized Geometry (optional):								

Exhibit 3 (continued)

PARSONS | Surface Radiation Field Measurement Datasheet (continued) | SOP-R-SUR-1-2-________ Page ___ of ___ | Revision 0 Date: ________

Measurement Location		Direct Surface Reading			Direct Surface Reading			Remarks
No.	Per Reference Map	Value (_____)	Channel (optional)	Instr. #	Value (____)	Channel (optional)	Instr. #	

Exhibit 4

PARSONS	Personnel Contamination Datasheet		SOP-R-SUR-1-3 ________ Revision 0 Page 1 of 2 Date: ________					
Individual' Name:			Employer			Employee #		
Individual's Address:			Permanent Work Location:					
No	Location (ref. Drawing attached)	Instrument	Activity	Activity Units	Instrument	Activity	Activity Units	Remarks/Comments

Instrumentment Data					Projected			
No	Manufacturer	Model	Seria	Attach Cal. Cert.	Lapsed Time for initial exposure		Basis:	
					Lapsed Time for residual exposure		Basis:	
					Decon Actions:			

Position	Name (Print)	Employer	No.	Permanent Work Location & phone #)	Signature	Date
Health and Safety						
Field Supervisor						
Health Physicist (if						
Surveyor						

Exhibit 4 (continued)

PARSONS Personnel Contamination Datasheet SOP-R-SUR-1-3 ______ Revision 0
Page 2 of 2 Date: ____

Analysis Health Physicist		Employer		Phone	
Analyst's Title		Permanent Work Location:			

Regulatory Basis for Analysis		Analysis/Calculation of Dose Required	Yes		No	

Dose Analysis (Reference applicable Parson's Calculation Procedure) (if required):

Projected Dose				Explanation & Comments:
Organ/Location	Dose (mrem)	Dose (TEDE)	Total Effective Dose Equivalent (TEDE) (see 10 CFR 20)	

Position	Name (Print)	Employer	No.	Permanent Work (& phone	Signature	Date
Original Project Manager					NA	NA
Analyst						
Reviewer		NA	NA	NA		

Table of Contents

1.0 PURPOSE

This procedure provides the requirements for measuring direct photon (gamma or x-ray) volume or surface activity using a ratemeter/scalar with detector, which assesses the dose in surface and volumetric contamination. The purpose of this procedure is to institute daily operational checks and to standardize the operation of the photon survey instrument to ensure that quality field measurements are obtained.

2.0 SCOPE

This instrument will be used to quantify radiological radiation fluxes and/or energies associated with photon-emitting radioisotopes in the ambient environment. This equipment maybe used to support decommissioning and/or impact assessment data collection under the requirements of the DOE, NRC, or EPA. This procedure maybe applied to other activities at the discretion of the Project Manager. This procedure can only be implemented by trained and qualified personnel.

The type and size of the scintillator in the detector is chosen to meet the data quality objectives in the task and the basis is documented in the applicable work plan or equivalent document. Typically larger detectors provide higher sensitivities but also have higher backgrounds values as well. This procedure addresses the typical 1X1, 2X2, and 3X3 inch cylindrical NaI detectors, but is applicable to most scintillation based photon detection systems. The special geometry detector used to provide enhanced detection and measurement capability for low energy photons, using the FIDLER probe, is addressed in SOP-R-SUR-004.

3.0 REFERENCES

1. NRC, 1997. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Final, December 1997.

2. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, *Quality Assurance Manual,* Parsons Infrastructure and RCTnology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

3. SOP-R-SUR-001, *GM Pancake Probe Surveys and Static Counts for Beta and Photon Activity for Environmental Investigations and Personnel Protection,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

4. SOP-R-MCA-002, *Gamma Spectroscopy Instrument Operation,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

5. SOP-R-SUR-004, *Collection, Handling, and Analysis of General Smear Samples for Environmental Investigations,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

6. SOP-R-SUR-004, *Surveys Using the FIDLER Detector,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

4.0 DEFINITIONS

1. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.
   - The materials associated with the radiation source and any associate container including back-scatter surfaces.

2. **Ratemeter** is an electronic device that sums pulses received from a detector over a set time period (typically very short) and displays this count in the form of equivalent counts per minute (cpm).

3. **Scalar** is similar to a ratemeter but this instrument counts the pulse for a time period, typically set by the operator, and displays the total counts for this time period.

4. **Scintillation detector** is a detector that is used to detect the presence of photon (i.e., gamma or x-ray) radiation. A scintillation detector typically consists of two components the scintillation material and a photomultiplier tube (or photodiode) in a single sealed light tight package. The scintillator produces a light pulse when it absorbs a photon, whose intensity is typically proportional to the energy of the photon. The photomultiplier tube (or photodiode) detects this pulse, multiplies its, and turns it into an electrical pulse that can be interpreted by a multichannel analyzer, ratemeter, scalar, or other counting system.

5. **Survey Area** is an area where radioactive materials or contamination are or may be present. Survey areas include areas where samples/smears (which may contain radioactivity) are being screened.

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

1. Use a scintillation detector and associated ratemeter instrument system specifically authorized by the PHP and/or identified in the work plan or equivalent document.

2. The survey requirement will be established by the work plan, safety plan, and/or equivalent documents for the project or specifically provided by the PHP.

3. Only qualified and trained personnel are allowed to implement this procedure.

4. A background determination and instrument operational check in accordance with this procedure shall be performed prior to the first use of the instrument on each shift.

5. The instrument shall be fully functional prior to using in the survey area.

6. If the instrument appears to have failed during use in the survey area, then leave the survey area immediately.

7. **NEVER ADJUST THE CALIBRATION CONTROLS.**

8. The count ratemeter, any cable (may be done per specific PHP direction and not invalidate calibration), and detector are calibrated as a unit and may not be interchanged without recalibration or surfaces with protrusions.

6.0 RESPONSIBILITIES

6.1 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the selection and survey requirements are consistent with the technical requirements of this procedure, the regulations, applicable project documentation, and good health physics practices.

2. Training the Radiological Control Technician (RCT) in the proper use of this procedure.

3. Providing independent review of the documentation and data to ensure it is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

4. Ensuring that the instruments are properly maintained and calibrated at specified intervals.

5. Training the RCTs in the proper use of this instrument.

6. Identification and specification of equivalent instrumentation to be used with this procedure.

7. Reviewing the instrument field test and measurement data to ensure that the data is consistent and credible, and following up on data anomalies.

6.2 Radiological Control Technicians (RCT) are responsible for:

1. Implementing this procedure and the applicable training.

2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

3. Reporting out of specification conditions to the Project Health Physicist and/or Field Supervisor.

4. Operating this instrument in accordance with this procedure and the applicable training.

5. Maintaining daily Operational check records for each instrument.

6. Documenting data collected using the instrument in accordance with appropriate regulations and procedures.

7. Reporting instrument malfunctions to the Project Health Physicist.

6.3 Project Manager (PM) (or designee, such as the field supervisor)

1. Provides required materials and trained/qualified personnel for implementation of the task.

2. Provides operational review of the project specific activities for these data collection activities.

3. Determines the applicability of this procedure beyond the areas specifically identified in Section 2.0.

6.4 Field Supervisor (FS)

1. PM site representative and responsible for routine supervision of the task.

2. Verifies completion of the task.

7.0 PROCEDURES

Note: When surveying, the detection of increases in activity can be more effectively identified by the audible sound than by monitoring the meter movement or digital display. Use the sound to locate the activity and the meter or display to assess the count rate or counts if available with the instrumentation.

Note: If at anytime during this procedure there are conditions that may impact the results note this information in the comment section or on the back of the applicable datasheet.

Note: This procedure is for using photon scintillation equipment specifically authorized by the PHP and/or the work plan or equivalent document.

CAUTION: When approaching unknown conditions be sure that the detector is on the highest scale and then reduce it to the appropriate scale once conditions are established. Extremely high radiation fluxes can result in saturation of this instrument and the reads dropping to zero. If the ratemeter/scalar fails to indicate the presence of normal ambient background leave the area immediately unless conditions can be established by other instrumentation. The absence of a background reading and audible counting (unless the speaker is turned off or no audible indication is provided) is an indication of instrument malfunction.

Note: Radioactive decay is a statistical phenomena and at low count rates the radiation emission rate will fluctuate significantly. In estimating count rates, the central tendency of the count rate (e.g., meter position) and not the upper or lower bound is relevant. It addition, in addressing survey activities, the background radiation from natural and unrelated man-enhanced radiation (e.g., fallout, some welding rods, exit signs, smoke detectors) typically changes significantly as a function of location due to changes in materials present. It is important to recognize that soils, rocks, concrete, blocks, and ceramics typically have significant levels of ambient background associated with them and care should be exercised to not miss-identify these materials as contaminated when only ambient background is present.

Note: Exhibits 1, 2, and 3 are typical examples, but the current version of these datasheets are maintained in SOP-R-SUR-001.

Note: It is acceptable to add attachments containing the information to the Daily Operational Check Log (Exhibit 1) and then reference these attachments (i.e., attachments are not included in the datasheet page count but are numbered separately) on the datasheet. In addition the Daily Operational Check Log maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

Note: If this activity involves a trainee then both the trainee and the RCT performing the on-the-job training print/initial/sign their names.

7.1 Prerequisite Actions

Note: It is acceptable to add attachments containing the information to the Daily Operational Check Log (Exhibit 1) and then reference this attachment (i.e., attachments are not included in the datasheet page count but are number separately) on the datasheet. In addition the Daily Operational Check Log maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

1.	PHP	Reviews the work plan, site data, regulatory requirements, customer requirements, and other applicable documentation with the PM and establishes the appropriate survey requirements, equivalent instrumentation, count times, and action levels for implementing this procedure.
2.	FS/ PHP	Directs initiation of the survey activity in accordance with this procedure.
3.	PHP	Provide the RCT with the data identified in steps 1 and 4.
4.	RCT	Ensure that meter (and detector, if independent) match the calibration certificate prior to operating. • Assign an unique meter number to the instrument, which does not have one. • Attach an identifying label to the side of the meter, which does not have one. Record the meter number, meter and detector serial numbers, and calibration information on the Survey Instrument Log.

5. RCT If missing, record the following information on the Daily Operational Check Log (Exhibit 1) prior to using the instrument. A separate log needs to be maintained for each instrument used.

- Project Title and Number,
- Meter Make/Model and Serial Number,
- Detector Make/Model and Serial Number,
- Last Date Calibrated,
- Calibration Due Date, and
- Applicable units for background and source counts (typically count or cpm).

6. RCT If the meter or detector is due for calibration, it must be tagged "Calibration Due" and given to the Project Health Physicist (or Field Supervisor if Project HP is unavailable). Instruments requiring calibration shall not be used for taking radiation measurements in survey areas.

7. RCT Check the high voltage setting and ensure that it is set as recommended on the appropriate meter calibration certificate. If the voltage is not properly set, contact the Project Health Physicist for further direction.

8. RCT Document these activities on the operational Daily Operational Check Log.

9. RCT Records the Background and Source Check count time for "Scalar" mode on the datasheet. If the instrument has no scalar mode record an "R" on the count time lines.

10. PHP Reviews the datasheet routinely and once it is completed per Section 7.7 and any data anomalies have been resolved signs and dates the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

11. General The data on the datasheet should not be released to the client until Step 10 has been completed.

7.2 Operational Checks

Note: This section of the procedure maybe implemented in conjunction with the sampling/survey activity. It is acceptable to add attachments containing the information to the Sampling/Survey Grid Datasheet and then reference this attachment on the datasheet. Any attachments are separately numbered and not part of the Datasheet page numbering.

1. RCT **Visual Inspection of Instrument--** Each instrument shall be inspected at the start of each work shift to identify potential problems or damage prior to being used in the survey area.

2. RCT **Visual Inspection of Instrument--** The date and time of this check and prints the name of the person performing the check shall be recorded on the Daily Operational Check Log (Exhibit 1) that corresponds to the meter/detector serial numbers in conjunction with documentation of the other activities in this section.

3.	RCT	**Visual Inspection of Instrument--** Visually check the instrument for signs of physical damage (e.g., broken or loose cables; missing screws or other parts; and inoperable switches or knobs) and ensure that the calibration due date has not passed.
4.	RCT	**Visual Inspection of Instrument--** Report any damage or other problems (not already documented on the log) to the Project Health Physicist to determine if the equipment can still be used. Malfunctioning instruments are not to be used in the survey area, without specific authorization of the Project Health Physicist.
5.	PHP	**Visual Inspection of Instrument—**Assesses the significance of the damage and based on good health physics practices and determines if the instrument should not be used. Also provide information based on this determination to the RCT to be record in the "Remarks" section.
6.	RCT	**Visual Inspection of Instrument—**If the instrument is damaged and should not be used (i..e., based on discussion with the {PHP) indicate "N" in the Visual/Battery Check portion of the log and terminated this procedure. Document the damage in the "Remarks" section.
7.	RCT	**Battery Check--**The batteries in each meter shall be checked at the start of each work shift to ensure proper operation prior to being used in the survey area. Turn the meter on and allow several minutes for the instrument to "warm-up" and stabilize.
8.	RCT	**Battery Check--** Test the batteries to ensure that the unit is functional by turning the dial to the "BAT" position. The battery strength is indicated by the needle deflection.
9.	RCT	**Battery Check--** If the meter reading indicates that the batteries are good (e.g., needle deflection into the "BAT TEST" portion of the scale), enter "OK" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column.
10.	RCT	**Battery Check--** If the batteries are weak, turn off the meter and replace the weak batteries with new batteries. Recheck the meter in accordance with Steps 7 to 10 ensure that the new batteries are good. If the meter indicates that the batteries are good, enter "Replaced" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column to indicate that the batteries were replaced.
11.	RCT	**Battery Check--** If the meter indicates that the new batteries are not good, replace the batteries again and retest the meter. If the meter is still not functioning properly after trying two new sets of batteries, take the meter out of service and contact the Project Health Physicist. Enter "F" (Failed) on the Daily Operational Check Log (Exhibit 1) under the "Battery Check" column to indicate that the meter was taken out of service.
12.	RCT	Continue Procedure In Section 7.3, Background Check.

7.3 Background Check

1. RCT After completing the visual inspection and battery check (see Section 7.2), a background check shall be performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift background check should be completed.

2. RCT Background readings shall be measured in a low background area to verify proper instrument operation by measuring a consistent background radiation level, and to ensure that the detector is not contaminated. When practicable, the background area selected shall be similar to the conditions encountered in each survey area. Obtain the source count jig.

3. RCT All background checks shall be conducted at the same location and in the source count jig to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials outside of the survey area, such as smears and air samples.

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

- Turn on the instrument.
- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.
- The "F-S" toggle switch to the slow response "S" mode, if applicable.
- Press the speaker button "ON", if applicable.

5. RCT The detector face is to be orientated with the face down, consistent with Section 7.4. Ensure that all radiation sources are removed (at least 10 feet away) from the area during the background check.

6. RCT If a ratemeter background is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

7. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column.

8. RCT If the scalar mode data is to be collected (i.e., a count time is specified), set the meter to scalar count time and the counting time to the value on the Daily Operational Check Log and initiate the scalar count.

9. RCT Record the reading in cpm or count on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column.

10. RCT Enter the background data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The background data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

11. RCT If this background data exceeds the allowed variation from the mean (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicates the instrument is beyond the acceptable tolerance for variability.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

12. RCT If the background reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column if at least 5 data points, widely separated in time, have been collected.

While the first 5 background values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of background through time, thus collection of several data point in a short time span does not provide useful data since the background variation is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

13. RCT If the background exceeds 2 standard deviations repeat steps 6 to 12 once, contact the PHP for instructions if the excess deviation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations criteria in step 12, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column. Also indicate the type of action (i.e., decontamination) that was taken for the recheck measurement.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

14. RCT If a source check is required proceed to Section 7.4.

15. RCT If a source check is not required complete return to the applicable section of this procedure.

7.4 Source Check

1. RCT After completing the background check (see Section 7.3), a source check is typically performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift source check should be completed. Obtain the source jig if it is not present from Section 7.3 activities.

2. RCT Source readings shall be measured in a low background area and in the source count jig to verify proper instrument operation by measuring a consistent source plus background radiation level, and to ensure that the detector is not contaminated.

3. RCT When practicable source checks shall be conducted at the same location to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials, such as smears and air samples, outside of the survey area.

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

- Turn on the instrument.
- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.
- The "F-S" toggle switch to the slow response "S" mode, if applicable.
- Press the speaker button "ON", if applicable.

5. RCT Obtain the check source(s) for this instrument. Use the source #(s) on the Daily Operational Check Log, if the data is unavailable use the source(s) designated by the PHP.

6. RCT Carefully place the source in the jig facing up.

CAUTION: *Do not contact the active surface of the sources* with your skin. This can result in unnecessary radiation exposure. These contact doses are typically significantly higher than generally expected by personnel. In addition, the chemical on the skin surface may damage the source invalidating its calibration and possibly causing the release of radioactive contamination.

7. RCT Orient the detector face so it is facing the source at the fixed distance and in the fixed orientation established by the jig. Ensure that all other radiation sources are removed (at least 10 feet away) from the area during the source check.

8. RCT If a ratemeter source check is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

9. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column, then go to step 12.

10. RCT If the scalar mode data is to be collected (i.e., a count time is specified), set the meter to scalar count time and the counting time to the value on the Daily Operational Check Log and initiate the scalar count.

11. RCT Record the reading in counts or cpm on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column.

12. RCT Enter the source check data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The source check data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

13. RCT If the source check data exceeds the allowed variation from the mean calculated in the control chart activities (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicate the instrument is beyond the acceptable tolerance for variability.

14. RCT If the source check reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 source check values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of the instrument performance through time, thus collection of several data point in a short time span does not provide useful data since the instrument performance is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

15. RCT If the source check value exceeds 2 standard deviations repeat steps 7 to 15 once, contact the PHP for instructions if this excess variation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations of the average for the control readings, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

16. RCT Describe any off-normal conditions that occurred during this process (this includes Sections 7.1 to 7.4 activities) in the "Remarks Column" and then initial entry.

17. RCT Return the source to the appropriate storage area.

18. RCT Record the data and time and initial the entry, then submit the datasheet to the FS.

19. FS Verify activity completion and initials after the RCT.

20. RCT Proceed to the applicable section for completion of data collection activities. At the termination of an activity or withdrawal of an instrument from usage arranges for transmission of the Daily Operational Check Log to the PHP for action and maintains a copy of this log in a manner consistent with the applicable Parsons/project records management procedure.

21. PHP Review the datasheet per Section 7.7, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

22. General The data on the datasheet should not be release to the client until Step 21 has been completed.

7.5 Survey of Surfaces or Items

Note: This instrument will be used to determine if radiological material (photon-emitting radioisotopes) are present in the volumes or surfaces of floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

Note: If this survey is implemented using a gamma spectrometer in either gross counting or spectral analysis modes see SOP-R-MCA-001 and SOP-R-MCA-002.

1. RCT Verify that Sections 7.1 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "N" to indicate that is a static count,
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and
- The count time indicated as "R".

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check source to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operation per Sections 7.1 to 7.4.

6. RCT Position the "F-S" toggle switch to the **"F" (fast)** mode and ensure the speaker is on.

7. RCT Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

8. RCT Scan at a rate of 1 inch every 2 seconds (or as specified by the PHP and noted on the datasheet remarks) to give the instrument time to respond. Scan rates greater than two inches per second drastically reduce the probability of detection. The operator should listen to the audio output closely since it responds faster than the meter reading.

9. RCT For a ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

10. RCT If the reading exceeds 100,000 dpm/100 cm^2 (1,670 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required.

11. RCT When surveying, any response above background should be investigated by holding the detector still to verify that the radiation rate is above background.

12. RCT If a reading above twice background or the action level provided by the PHP for this survey is confirmed, a static measurement should be taken in accordance with Section 7.6 of this procedure.

13. RCT Continue scanning the entire surface within the designated area.

14. RCT If localized contamination is found the RCT may, decontaminate the surface per applicable Parsons procedure or other instructions provided by the Project Health Physicist.

15. RCT Resurvey the decontaminated areas per Steps 7 through 15.

16. RCT Record the scanning (i.e., highest reading in the area after any localized decontamination) and decontamination information on the Surface Radiation Field Measurement Data Sheet (see Exhibit 3).

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

17. RCT Repeat Steps 8 through 17 for each surface measurement location.

18. RCT Per direction of the PHP/FS or at the RCT discretion complete Sections 7.3 and/or 7.4 to re-verify instrument performance. This is often completed whenever there is a break in work activities.

19. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

20. FS Review and if completed properly, sign and date the datasheet, then store this in-process record in accordance with applicable Parsons and project procedures and client requirements.

21. PHP Review the datasheet per Section7.7, and once any data anomalies have been resolved, sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

22. General The data on the datasheet should not be release to the client until Step 21 has been completed.

7.6 Field Static Counts

Note: This instrument will be used to determine if radiological material (photon-emitting radioisotopes) are present in the volumes or surfaces of floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: If this survey is implemented using a gamma spectrometer in either gross counting or spectral analysis modes see SOP-R-MCA-001 and SOP-R-MCA-002.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

1. RCT Verify that Sections 7.1 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "Y" or "N" to indicate if this is a static count,
- Specify survey distance (unless typically 0.5 ± 0.5 cm is used) is required record this value in cm, and

The count time in minutes, indicate "R" in this space if the survey is being made in ratemeter mode.

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.2 to 7.4.

6. RCT Position the "F-S" toggle switch to the **"F" (fast)** mode and ensure the speaker is on.

7. RCT Per direction of the PHP/FS or at the RCT discretion complete Sections 7.3 and/or 7.4 to re-verify instrument performance. This is often completed whenever there is a break in work activities.

8. RCT Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

9. RCT If this is a scalar mode measurement initiate a scalar count or if a ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

10. RCT If the reading exceeds 100,000 dpm/100 cm^2 (1,670 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required.

11. RCT Record the surface reading in cpm on the Surface Radiation Field Measurement Data Sheet (Exhibit 3). The location of the measurement is also to be recorded on the Data Sheet.

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

12. RCT Repeat Steps 8 through 12 for each location.

13. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

14. FS Review and if completed properly, sign and date the datasheet, then stores this in-process record in accordance with applicable Parsons and project procedures and client requirements.

15. PHP Review the datasheet per Section7.7, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

16. General The data on the datasheet should not be release to the client until Step 15 has been completed.

7.7 Data Verification

This is the initial step in the verification and validation of the data generated by this procedure, the final steps will be addressed by the verification and validation process describe in the applicable workplan or similar document.

1. HP On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibit 1) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).
2. HP Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.
3. HP Review the data for the following technical considerations:
   - Are the data technical consistent,
   - Are the calibrations of the instrument current, valid for the intended use, and of sufficient accuracy for the intended use,
   - Were appropriate and current calibration and check sources used,
   - Is there appropriate documentation for all calibrations (e.g., meters, detectors, and sources) in the records,
   - Are the background values credible and are the background data consistent with the statistical variability expected,
   - Are the expected progeny present and in the appropriate ratios based on relative activities.
   - Is the expected level of background radiation present.
   - Have appropriate backgrounds data set been obtained,
   - Is there consistency between these values and the other survey data,
   - Are the radiation types and radionuclides present in credible relative ratios,
   - Is additional count time required to meet data quality objectives,,
   - Does the equipment appear to be functioning properly,
   - Were any technical concerns/inconsistencies appropriately followed up on and resolved, and
   - Are there any other outstanding technical, operational, or quality issues associated with the data.
4. HP If there are problems or potential problems associated the data, the HP initiates the any designated SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.
5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.
6. HP Documents the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification.

7. HP Once the datasheet is completed and any applicable NCRs are generated, signs and dates the Datasheets as verified (i.e., verified pending resolution of outstanding NCRs) and stores the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure.

8.0 RECORDS

Exhibits 1 and 3 with any associated attachments and applicable associated NCRs are the quality records generated by this procedure.

Exhibit 1

PARSONS

Daily Operational Check Log
Instrument #__________

SOP-R.SUR-1-1 -__________ Page __ of __
Revision 0
Last Date Calibrated: __________

Calibration Due Date: __________

Project Title: __________
Project Number: __________
Prepared By Print: __________
Prepared By Signature: __________ Date: ______
Verified By Signature: __________ Date: ______

Meter Make/Model: __________
Meter Serial No.: __________
Detector Make/Model: __________
Detector Serial No.: __________

(optional data enter as needed)
Isotope: _____ Efficiency: _____
Isotope: _____ Efficiency: _____
Isotope: _____ Efficiency: _____
Isotope: _____ Efficiency: _____
Channel 1 Window: _____ to _____ (keV)
Channel 2 Window: _____ to _____ (keV)

Voltage Consistent With Calibration Certificate			No	Acceptable Background Range		Acceptable Source Check Range	

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (___-minute Scalar)	Remarks	Pass/ Fail		

Exhibit 1 (Continued)

PARSONS

Daily Operational Check Log (Continuation Sheet)
Instrument #__________

SOP-R.SUR-1-1 -__________ Page __ of __
Revisions 0

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (__-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (___-minute Scalar)	Source #	Pass/ Fail		

Exhibit 2
Example of a Control Chart

Parameter Being Tracked	Cs-137 0.661 MeV peak counts, post fine tuning
	Electectronics
Instrument Type	URSA-MCA
Model Number	Universal Radiation Spectrum Analyzer
Manufacturer	RSA
Serial Number	20291
	Detector
Instrument Type	Fidler
Model Number	M-23
Manufacturer	Ortec
Serial Number	X-111
Geometry	Center Line Area Source at 4"
ROI	Cs-137 0.661 MeV peak
	Count Data
	Mean= 897.1667
	STDEV= 71.46025

Date/Time	Data Number	Data	Pull Block	Status
1/1/00 0:00	1	905	[redacted]	[redacted]
1/5/00 0:00	3	1001	[redacted]	[redacted]
1/6/00 0:00	4	787	[redacted]	[redacted]
1/7/00 0:00	5	923	[redacted]	[redacted]
1/10/00 0:00	6	911	[redacted]	OK
1/2/00 0:00	2	856	[redacted]	[redacted]

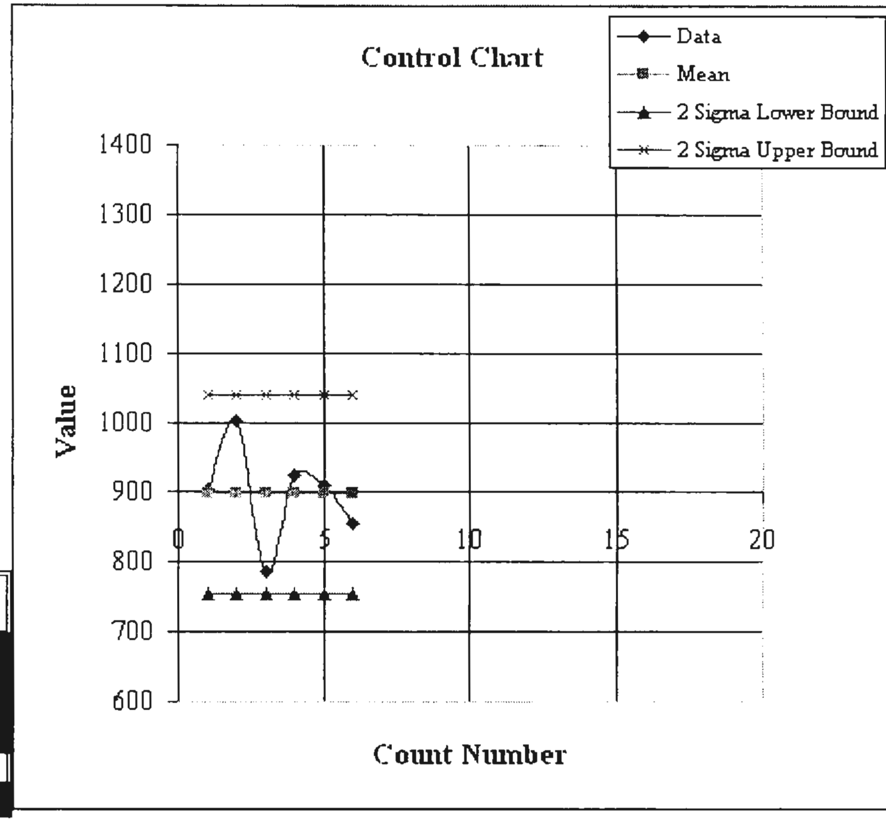


Exhibit 3

PARSONS

Surface Radiation
Field Measurement Datasheet

SOP-R-SUR-1-2- ____________ Revision 0
Page ___ of ___ Date: ____________

Project Title: ______________________
Project Number: ______________________
Building/area/Floor: ______________________
Room/unit Designation: ______________________

Surveyor (print):__________ Surveyor Signature:__________ Date: ______
Verifier (print): __________ Verifier Signature: __________ Date: ______
Complete FS (print):__________ FS Signature: __________ Date: ______

Measurement Location		Direct Surface Reading static (Y/N) ☐ Type ______ Count Time (M) ______			Direct Surface Reading static (Y/N) ☐ Type ______ Count Time (M) ______			Alt. Distance (optional) ______cm (left instr) Alt. Distance (optional) ______cm (right instr)
No	Per Reference Map	Value (______)	Channel (optional)	Instr. #	Value (______)	Channel (optional)	Instr. #	Remarks
Instr. Check Source								

Specialized Geometry (optional):

Exhibit 3 (continued)

PARSONS — Surface Radiation Field Measurement Datasheet (continued) — SOP-R-SUR-1-2- ________ Revision 0 — Page ___ of ___ — Date: ________

Measurement Location		Direct Surface Reading			Direct Surface Reading			Remarks
No	Per Reference Map	Value (______)	Channel (optional)	Instr. #	Value (______)	Channel (optional)	Instr. #	

Table of Contents

1.0 PURPOSE

This procedure provides the requirements and techniques for collecting smear samples to determine removable radioactive surface contamination. The purpose of taking removable surface measurements is to determine the extent of radioactive contamination, to evaluate the potential for its migration, and to assess methods for its decontamination. This procedure is intended to standardize the collection of smear samples for the collection of radiological data on removable contamination.

2.0 SCOPE

This procedure establishes the requirements for performance, documentation, and review of surface contamination surveys. This collection of smears is used to quantify removable radiological contamination that may be present on the surfaces of floors, walls, or equipment. Note, the collection of a smear sample actually alters the radiological conditions by removing some of the removable contamination present on the surface.

This collection process maybe used to support decommissioning and/or impact assessment data collection under the requirements of the DOE, NRC, DOT, or EPA. This procedure maybe applied to other activities at the discretion of the Project Manager. This procedure can only be implemented by trained and qualified personnel.

3.0 REFERENCES

1. NRC, 1997. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Final, December 1997.

2. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, *Quality Assurance Manual,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

3. SOP-G-SM-001, *Sample Chain-of-Custody Control,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

4.0 DEFINITIONS

1. **Direct Surface Contamination Monitoring** is a measure of the total radioactivity present on a surface and does not differentiate between fixed and removable (i.e., loose) surface contamination.

2. **Fixed contamination** is radioactive material that is attached or contained in or on a surface in such a manner that it is not readily moved by collection of smears from the surface and/or routine activities.

3. **Removable contamination** is radioactive material that may be remove from a surface by collection of smears and/or routine activities.

4. **Representative sample** is a sample which is reproducible and for which the activity collected is related to the activity present based on a know relationship with an acceptable level of accuracy.

5. **Smear** is the collection of a representative sample of the removable radiological contamination on a surface base on passing an absorbent material in contact with the surface under moderate pressure over the surface. Typically it is assumed that the collection efficiency of a smear is on the order of 10%, to ensure conservative controls.

6. **Survey Area** is an area where radioactive materials or contamination are or may be present. Survey areas include areas where samples/smears (which may contain radioactivity) are being screened.

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

1. Latex or nitrile gloves shall be worn (and changed when contaminated or torn) when taking smears where radiological contamination is present or suspected. A pair of cotton gloves may be worn under the latex or nitrile gloves.

2. The survey requirement will be established by the work plan, safety plan, and/or equivalent documents for the project or specifically provided by the PHP.

3. Only qualified and trained personnel are allowed to implement this procedure.

4. The surfaces from which a sample is collected must be smooth enough that the smear is not significantly damaged in collection of the sample and the smear contacts most of the surface. Potentially deviations from this condition must be clearly documented in data collection documentation.

5. Clearly label and contain all smears after collection.

6. Maintain chain of custody on all smears.

7. Surfaces conditions, smear collection technique, and smear materials must result in a representative sample of the removable contamination on the surface or alternative methods for sample collection should be evaluated.

8. Hands shall be periodically checked for contamination.

6.0 RESPONSIBILITIES

6.1 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the location selection and survey requirements are consistent with the technical requirements of this procedure, the regulations, applicable project documentation, and good health physics practices.

2. Training the Radiological Control Technician (Tech) in the proper use of this procedure.

3. Providing independent review of the documentation and data to ensure it is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

4. Training the Techs in the proper use of this procedure.

5. Identification and specification of equivalent techniques/processes if needed.

6. Reviewing the data to ensure that the data is consistent and credible, and following up on data anomalies.

7. Arrange for archiving and/or appropriate disposal for all smears after analysis.

6.2 Technicians (Tech) are responsible for:

1. Implementing this procedure and the applicable training.

2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

3. Reporting out of specification conditions to the Project Health Physicist and/or Field Supervisor.

4. Maintain chain of custody on all smear samples.

6.3 Project Manager (PM) (or designee. such as the field supervisor)

1. Provides required materials and trained/qualified personnel for implementation of the task.

2. Provides operational review of the project specific activities for these data collection activities.

3. Determines the applicability of this procedure beyond the areas specifically identified in Section 2.0.

6.4 Field Supervisor (FS)

1. PM site representative and responsible for routine supervision of the task.

2. Arranges for the storage and/or disposal of smear while in process, to ensure chain of custody is maintained.

3. In conjunction with the PHP, arrange for archiving and/or appropriate disposal for all smears after analysis

4. Verifies completion of the task.

7.0 PROCEDURES

Note: If at anytime during this procedure there are conditions that may impact the results, note this information in the remarks section or on the back of the applicable datasheet.

CAUTION: Smear are potentially contaminated materials and should be handled and disposed of as such. Note, the potential contamination maybe associated with radiological, chemical, and/or biological contaminates dependent on the source location.

Note: If this activity involves a trainee then both the trainee and the Tech performing the on-the-job training print/initial/sign their names.

Note: This smear collection activity maybe conducted simultaneously with other activities, implemented in accordance with other sections of this procedure or other applicable procedures. Regulatory smears are always collected before large area smears unless the large area smear is part of the decontamination process. Smears are generally collected after the survey and counting activities in a location are completed.

7.1 Regulatory Compliance Smears

Note: It is acceptable to add attachments containing the information to the Smear Collection Datasheet (Exhibit 1) and then reference these attachments (i.e., attachments are not included in the datasheet page count but are number separately) on the datasheet. In addition the Smear Collection Datasheet maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued. Implement the Chain-of-Custody process for the sample, which this is typically a project related procedure and form, although SOP-G-SM-001 maybe used as needed.

Note: The PHP will designate the area (i.e., the number of cm^2) to be smeared. Typically 300 cm^2 are is used for DOT related smears. 100 cm^2 smears are also often taken for regulatory purposes. The shape of the smeared area is not important, although it usually is located at area of projected highest contamination levels. If you are unable to smear the required area, note the problem in the remarks section.

Note: Although glassine storage envelopes are preferred, historical practice has indicated that the use of paper envelopes should not significantly impact the smear activity. It is essential that materials with a static charge, such as plastics, are not placed in contact with the collection surface of the smear or air sample.

1.	PHP	Reviews the work plan, site data, regulatory requirements, customer requirements, applicable field survey instruments, and other applicable documentation with the PM and establishes the appropriate smear sampling requirements, smear collection areas, designates smear collection material, smear containers, and regulatory significance for implementing this procedure.
2.	FS/ PHP	Directs initiation of the survey activity in accordance with this procedure.
3.	PHP	Provide the Tech with the data identified in step 5.
4.	Tech	Obtains the designated smear collection material, smear containers, smear collection template (if required), and Smear Collection Datasheet.

5. Tech Record the following information on the Smear Collection Datasheet (Exhibit 1) prior to smear collection:

- Project Title and Number,
- Location of the smears to be collected,
- Collector/Surveyor and FS name,
- Datasheet number,
- Indicate if the smears are to archived and if so where,
- Indicate the type of smear container to be used, if any,
- Applicable field survey instruments (i.e., instrument number and type), and
- Check the intended use of the smears (check as many as appropriate).

6. Tech Proceed to the first smear collection location and record the location number and map reference.

7. Tech Label the storage container and/or smear (see Exhibit 2).

8. Tech Place the template over the area to be smeared, taking care to ensure that the areas where the smear is to be collected is not disturbed.

9. Tech **CAUTION: Use caution in surveying rough surfaces to avoid personal injury or tearing of the smear paper.**

CAUTION: Handle smear papers carefully to prevent personal contamination or the spread of contamination.

Hold the smear paper such that the back of the smear is against the fingers. Place the face of the smear paper against the surface to be smeared.

10. Tech Smear an area of designated size [e.g., approximately 100 square centimeters (16 square inches)] making a single pass over the area with moderate pressure. If a template is used stay with the template area.

11. Tech If a special action level for the smears have been established, survey the smear in accordance with the appropriate procedure and implement the designated actions if the action level is exceeded.

12. Tech Survey the smear using the designated survey instruments, in accordance with applicable survey/static count procedures and document these results on the Smear Collection Datasheet. If the smear is larger than the probe area survey the smear and then do a static count on the highest contamination level.

CAUTION: If safety action levels are exceeded implement the applicable portions of the safety plan based on these survey and any other applicable data.

Note: The prepoperational, source, and background checks for the instrumentation must be completed and documented in accordance with the applicable procedure, however the field survey/static count results should be documented on the Smear Collection Datasheet..

13. Tech — Place each smear in a typically pre-labeled envelope or other suitable holder to prevent cross contamination and loss of chain of custody on data.

14. Tech — Record the area surveyed and any relevant remarks addressing off-normal conditions or problems.

15. Tech — Repeat steps 6 through 15 to all location have been addressed to this activity.

16. Tech — Leave the potentially affected area.

17. Tech — Initiate applicable chain-of-custody process and record the applicable COC documentation number for each smear sample.

18. Tech — Sign and date the Smear Collection Datasheet.

19. FS — Verify completion of the task and then sign and date the Smear Collection Datasheet.

20. PHP — Review the datasheet routinely and once it is completed per Section 7.3, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

21. General — The data on the smears on the datasheet should not be release to the client until Step 20 has been completed.

7.2 General Area Smears

Note: It is acceptable to add attachments containing the information to the Smear Collection Datasheet (Exhibit 1) and then reference these attachments (i.e., attachments are not included in the datasheet page count but are number separately) on the datasheet. In addition the Smear Collection Datasheet maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

Note: The shape of the smeared area is not important, although it usually is located at area of projected highest contamination levels. If you are unable to smear the required area, note the problem in the remarks section.

Note: Although glassine storage envelopes are preferred, historical practice has indicated that the use of paper envelopes should not significantly impact the smear activity. Note general area smears are collected as part of a general survey of the area and typically involve a significantly larger area and limited documentation. These smears are considered working information.

1. PHP — Reviews the work plan, site data, regulatory requirements, customer requirements, applicable field survey instruments, disposition of the smears, applicable chain-of-custody requirements, and other applicable documentation with the PM and establishes the appropriate survey requirements, smear collection areas, designates smear collection material, smear containers, and regulatory significance for implementing this procedure.

2.	FS/ PHP	Directs initiation of the survey activity in accordance with this procedure.
3.	PHP	Provide the Tech with the data identified in step 5.
4.	Tech	Obtains the designated smear collection material, smear containers (if applicable), and Smear Collection Datasheet.
5.	Tech	Record the following information on the Smear Collection Datasheet (Exhibit 1) prior to smear collection:

- Project Title and Number,
- Location of the smears to be collected,
- Collector/Surveyor and FS name,
- Datasheet number,
- Indicate if the smears are to archived and if so where,
- Indicate the type of smear container to be used, if any,
- Applicable field survey instruments (i.e., type and number), and
- Check the intended use of the smears (check as many as appropriate).

6.	Tech	Proceed to the first smear collection location and record the location number and map reference.
7.	Tech	Label the storage container and/or smear (see Exhibit 2), if applicable.
8.	Tech	**CAUTION: Use caution in surveying rough surfaces to avoid personal injury or tearing of the smear material.**

CAUTION: Handle smear papers carefully to prevent personal contamination or the spread of contamination.

Hold the smear paper such that the back of the smear is against the fingers or device. Place the face of the smear paper against the surface to be smeared.

9.	Tech	Smear the area of interest making a single pass over the area with moderate pressure.
10.	Tech	Survey the smear using the designated survey instruments, in accordance with applicable survey/static count procedures and document these results on the Smear Collection Datasheet. If the smear is larger than the probe area survey the smear and then do a static count on the highest contamination level.

CAUTION: If safety action levels are exceeded implement the applicable portions of the safety plan based on these survey and any other applicable data.

Note: The preoperational, source, and background checks for the instrumentation must be completed and documented in accordance with the applicable procedure, however the field survey/static count results should be documented on the Smear Collection Datasheet.

11.	Tech	Place each smear in a typically pre-labeled envelope or other suitable holder to prevent cross contamination and loss of chain of custody on data, if it is to evaluated later, other wise discard as potentially contaminated waste.
12.	Tech	Record the area surveyed and any relevant remarks addressing off-normal conditions or problems.
13.	Tech	Repeat steps 5 to 13 for all location have been addressed to this survey activity.
14.	Tech	Leave the potentially affected area.
15.	Tech	Initiate applicable chain-of-custody process and record the applicable COC documentation number for each smear sample, if required
16.	Tech	Sign and date the Smear Collection Datasheet.
17.	FS	Verify completion of the task and then sign and date the Smear Collection Datasheet.
18.	PHP	Review the datasheet routinely and once it is completed per Section 7.3, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.
19.	General	The data on the datasheet should not be release to the client until Step 7.120 has been completed.

7.3 Collection Data Verification and Validation

This is the initial step in the verification and validation of the data generated by this procedure, the final steps will be addressed by the verification and validation process describe in the applicable workplan or similar document.

1.	HP	On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibit 1) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).
2.	HP	Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.
3.	HP	Review the data for the following technical considerations:

- Are the data technically consistent,
- Are the calibrations of the instrument current, valid for the intended use, and of sufficient accuracy for the intended use,
- Were appropriate and current calibration and check sources used,
- Is there appropriate documentation for all calibrations (e.g., meters, detectors, and sources) in the records,
- Are the expected progeny present and in the appropriate ratios based on relative activities,

- Is the expected level of background radiation present,
- Have appropriate backgrounds data set been obtained,
- Is there consistency between these values and the other survey data,
- Are the radiation types and radionuclides present in credible relative ratios,
- Were any technical concerns/inconsistencies appropriately followed up on and resolved, and
- Are there any other outstanding technical, operational, or quality issues associated with the data.

4. HP If there are problems or potential problems associated the data, the HP initiates the any designated SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.

5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.

6. HP Document the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification.

7. HP Once the datasheet is completed and any applicable NCRs are generated, sign and date the Datasheets as verified (i.e., verified pending resolution of outstanding NCRs) and store the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure.

8.0 RECORDS

Exhibits 1, any chain-of-custody forms generated, and any associated attachments and any applicable associated NCRs are the quality records generated by this procedure.

Exhibit 1

PARSONS — **Smear Collection Datasheet** — SOP-R-SUR-4-1-________ Revision 0

Page ___ of ___ Date: ________

Project Title: ________________

Surveyor (print): ________ Surveyor Signature: ________ Date: ____

Project Number: ________________

Verifier (print): ________ Verifier Signature: ________ Date: ____

Building/area/Floor: ________________

Room/Unit Designation: ________________

Complete FS (print): ________ FS Signature: ________ Date: ____

Survey Instrument 1:	Model		No.		Survey Instrument 2:	Model		No.	
Smear to be Archived	Yes		No		Container Used:		Glassine Envelope		Paper Envelope		Discarded After Field Counting
Archival Location (optional)		Intended Use:		Health and Safety Controls		DOT Shipping		Establishing Compliance

No	Per Reference Map	Area (cm^2)	COC #	Survey Instrument 1		Survey Instrument 2		Check if these are H-3 (i.e., tritium) smears
				Value	Units	Value	Units	Remarks

Exhibit 1 (continued)

PARSONS Smear Collection Datasheet (continued) SOP-R.SUR-4-1 -___________

No	Per Reference Map	Area (cm^2)	COC #	Survey Instrument 1		Survey Instrument 2		
				Value	Units	Value	Units	Remarks

Exhibit 2

Sample Numbering

Sample numbering can be in any format and method specified in the work plan or by the PHP as long as it ensures that there are unique location and sample numbers for all locations at which survey data is taken and all samples. If not designated in any other manner the following sample number protocol should be followed.

BD-RM-UFS-GD-x-y-z-ddmmyy

Where:

- BD is the building designation,
- RM is the room designation,
- UFS is the unfolded rooms surface designation from the Sampling/Survey Grid Datasheet's graphical
  description.
- GD is the sampling location grid designator.
- x-y-z is the coordinates within the grid (may be eliminated if they same coordinates are used for all grids), the z value should be proceed by an "a" if the value is the distance out of the surface rather than into the surface.
- date of the sample collection if more than one sample is taken otherwise not necessary.

Table of Contents

1.0 PURPOSE

This procedure provides the requirements for measuring direct photon (gamma or x-ray) volume or surface activity using a ratemeter with detector, which assesses the dose in ⊠rad/hr (or ⊠R/hr). The purpose of this procedure is to institute daily operational checks and to standardize the operation of the photon survey instrument to ensure that quality field measurements are obtained.

2.0 SCOPE

This instrument will be used to quantify radiological dose rates(photon-emitting radioisotopes) in the ambient environment.

This procedure is applicable to the collection of photon emission data, unrelated to energy of the emission, and exposure rate data within the limitations of the response of the detector. This equipment maybe used to support decommissioning and/or impact assessment data collection under the requirements of the DOE, NRC, or EPA. This procedure maybe applied to other activities at the discretion of the Project Manager. This procedure can only be implemented by trained and qualified personnel.

The type and size of the scintillator in the detector is chosen to meet the data quality objectives in the task and the basis is documented in the applicable work plan or equivalent document. Typically larger detector provide higher sensitivities but also have higher backgrounds values as well. This procedure addresses the typical 1X1, 2X2, and 3X3 inch cylindrical NaI detectors, but is applicable to most scintillation based photon detection systems.

3.0 REFERENCES

1. NRC, 1997. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Final, December 1997.

2. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, *Quality Assurance Manual,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

3. SOP-R-MCA-001, *GM Pancake Probe Surveys and Static Counts for Beta and Photon Activity for Environmental Investigations and Personnel Protection,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

4. SOP-R-MCA-002, *Gamma Spectroscopy Instrument Operation,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

5. SOP-R-SUR-004, *Collection, Handling, and Analysis of General Smear Samples for Environmental Investigations,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

4.0 DEFINITIONS

1. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.
   - The materials associated with the radiation source and any associate container including back-scatter surfaces.

2. **Ratemeter** is an electronic device that sums pulses received from a detector over a set time period (typically very short) and displays this count in the form of equivalent counts per minute (cpm).

3. **Scalar** is similar to a ratemeter but this instrument counts the pulse for a time period, typically set by the operator, and displays the total counts for this time period.

4. **Scintillation detector** is a detector that is used to detect the presence of photon (i.e., gamma or x-ray) radiation. A scintillation detector typically consists of two components the scintillation material and a photomultiplier tube (or photodiode) in a single sealed light tight package. The scintillator produces a light pulse when it absorbs a photon, whose intensity is typically proportional to the energy of the photon. The photomultiplier tube (or photodiode) detects this pulse, multiplies its, and turns it into an electrical pulse that can be interpreted by a multichannel analyzer, ratemeter, scalar, or other counting system.

5. **Survey Area** is an area where radioactive materials or contamination are or may be present. Survey areas include areas where samples/smears (which may contain radioactivity) are being screened.

6. **⊠R or ⊠rad ratemeter** is an instrument that measure the integrated energy deposited in a unit volume of material (i.e., ⊠R the material is air or ⊠rad the material is tissue) from the absorption of typically photon (i.e., gamma and x-ray) radiation. Although this instrumentation is often referred as a *⊠R-ratemeter* is more useful if it is calibrated to provide a measure of dose in ⊠rad. The instrumentation in this procedure will have been calibrated to provide data in ⊠rad/hr to allow assessment of dose rate.

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

1. Use a scintillation detector and associated ratemeter instrument system specifically authorized by the PHP and/or identified in the work plan or equivalent document.

2. The survey requirement will be established by the work plan, safety plan, and/or equivalent documents for the project or specifically provided by the PHP.

3. Only qualified and trained personnel are allowed to implement this procedure.

4. A background determination and instrument operational check in accordance with this procedure shall be performed prior to the first use of the instrument on each shift.

5. The instrument shall be fully functional prior to using in the survey area.

6. If the instrument appears to have failed during use in the survey area, then leave the survey area immediately.

7. **NEVER ADJUST THE CALIBRATION CONTROLS.**

8. The count ratemeter, any cable, and detector are calibrated as a unit and may not be interchanged without recalibration or surfaces with protrusions, without express permission of the PHP.

6.0 RESPONSIBILITIES

6.1 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the selection and survey requirements are consistent with the technical requirements of this procedure, the regulations, applicable project documentation, and good health physics practices.

2. Training the Radiological Control Technician (RCT) in the proper use of this procedure.

3. Providing independent review of the documentation and data to ensure it is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

4. Ensuring that the instruments are properly maintained and calibrated at specified intervals.

5. Training the RCTs in the proper use of this instrument.

6. Identification and specification of equivalent instrumentation to be used with this procedure.

7. Reviewing the instrument field test and measurement data to ensure that the data is consistent and credible, and following up on data anomalies.

6.2 Radiological Control Technicians (RCT) are responsible for:

1. Implementing this procedure and the applicable training.

2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

3. Reporting out of specification conditions to the Project Health Physicist and/or Field Supervisor.

4. Operating this instrument in accordance with this procedure and the applicable training.

5. Maintaining daily Operational check records for each instrument.

6. Documenting data collected using the instrument in accordance with appropriate regulations and procedures.

7. Reporting instrument malfunctions to the Project Health Physicist.

6.3 Project Manager (PM) (or designee, such as the field supervisor)

1. Provides required materials and trained/qualified personnel for implementation of the task.

2. Provides operational review of the project specific activities for these data collection activities.

3. Determines the applicability of this procedure beyond the areas specifically identified in Section 2.0.

6.4 Field Supervisor (FS)

1. PM site representative and responsible for routine supervision of the task.

2. Verifies completion of the task.

7.0 PROCEDURES

Note: When surveying the detection of increases in activity can be more effectively identified by the audible sound than by monitoring the meter movement or digital display. Use the sound to locate the activity and the meter or display to assess the count rate or counts if available with the instrumentation.

Note: If at anytime during this procedure there are conditions that may impact the results note this information in the comment section or on the back of the applicable datasheet.

Note: This procedure is for using photon scintillation equipment specifically authorized by the PHP and/or the work plan or equivalent document.

CAUTION: This equipment should not be used to assess safety conditions in areas where significant dose rates maybe present. When approaching unknown conditions be sure that the detector is on the highest scale and then reduce it to the appropriate scale once conditions are established. Extremely high radiation fluxes can result in saturation of this instrument and the reads dropping to zero. If the ratemeter/scalar fails to indicate the presence of normal ambient background leave the area immediately unless conditions can be established by other instrumentation. The absence of a background reading and audible counting (unless the speaker is turned off or no audible indication is provided) is an indication of instrument malfunction.

Note: Radioactive decay is a statistical phenomena and at low count rates the radiation emission rate will fluctuate significantly. In estimating count rates, the central tendency of the count rate (e.g., meter position) and not the upper or lower bound is relevant. In addition, in addressing survey activities, the background radiation from natural and unrelated man-enhanced radiation (e.g., fallout, some welding rods, exit signs, smoke detectors) typically changes significantly as a function of location due to changes in materials present. It is important to recognize that soils, rocks, concrete, blocks, and ceramics typically have significant levels of ambient background associated with them and care should be exercised to not miss-identify these materials as contaminated when only ambient background is present.
Note: Exhibits 1, 2 and 3 are typical examples, but the current version of these datasheets are maintained in SOP-R-SUR-001.

Note: It is acceptable to add attachments containing the information to the Daily Operational Check Log (Exhibit 1) and then reference these attachments (i.e., attachments are not included in the datasheet page count but are numbered separately) on the datasheet. In addition the Daily Operational Check Log maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

Note: If this activity involves a trainee then both the trainee and the RCT performing the on-the-job training print/initial/sign their names.

7.1 Prerequisite Actions

Note: It is acceptable to add attachments containing the information to the Daily Operational Check Log (Exhibit 1) and then reference these attachments (i.e., attachments are not included in the datasheet page count but are number separately) on the datasheet. In addition the Daily Operational Check Log maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

1.	PHP	Reviews the work plan, site data, regulatory requirements, customer requirements, and other applicable documentation with the PM and establishes the appropriate survey requirements, equivalent instrumentation, count times, and action levels for implementing this procedure.
2.	FS/ PHP	Directs initiation of the survey activity in accordance with this procedure.
3.	PHP	Provide the RCT with the data identified in steps 1 and 4.
4.	RCT	Ensure that meter (and detector, if independent) match the calibration certificate prior to operating. • Assign an unique meter number to the instrument, which does not have one. • Attach an identifying label to the side of the meter, which does not have one. Record the meter number, meter and detector serial numbers, and calibration information on the Survey Instrument Log.

5. RCT If missing, record the following information on the Daily Operational Check Log (Exhibit 1) prior to using the instrument. A separate log needs to be maintained for each instrument used.

- Project Title and Number,
- Meter Make/Model and Serial Number,
- Detector Make/Model and Serial Number,
- Last Date Calibrated,
- Calibration Due Date, and
- Applicable units for background and source counts (typically ⊠rad/hr).

6. RCT If the meter or detector is due for calibration, it must be tagged "Calibration Due" and given to the Project Health Physicist (or Field Supervisor if Project HP is unavailable). Instruments requiring calibration shall not be used for taking radiation measurements in survey areas.

7. RCT Check the high voltage setting and ensure that it is set as recommended on the appropriate meter calibration certificate. If the voltage is not properly set, contact the Project Health Physicist for further direction.

8. RCT Document these activities on the operational Daily Operational Check Log.

9. RCT Records the Background and Source Check count time for "Scalar" mode on the datasheet. If the instrument has no scalar mode record an "R" on the count time lines.

10. PHP Reviews the datasheet routinely and once it is completed per Section 7.6 and any data anomalies have been resolved signs and dates the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

11. General The data on the datasheet should not be release to the client until Step 10 has been completed.

7.2 Operational Checks

Note: This section of the procedure maybe implemented in conjunction with the sampling/survey activity. It is acceptable to add attachments containing the information to the Sampling/Survey Grid Datasheet and then reference this attachment on the datasheet. Any attachments are separately numbered and not part of the Datasheet page numbering.

1. RCT **Visual Inspection of Instrument--** Each instrument shall be inspected at the start of each work shift to identify potential problems or damage prior to being used in the survey area.

2. RCT **Visual Inspection of Instrument--** The date and time of this check and prints the name of the person performing the check shall be recorded on the Daily Operational Check Log (Exhibit 1) that corresponds to the meter/detector serial numbers in conjunction with documentation of the other activities in this section.

3.	RCT	**Visual Inspection of Instrument--** Visually check the instrument for signs of physical damage (e.g., broken or loose cables; missing screws or other parts; and inoperable switches or knobs) and ensure that the calibration due date has not passed.
4.	RCT	**Visual Inspection of Instrument--** Report any damage or other problems (not already documented on the log) to the Project Health Physicist to determine if the equipment can still be used. Malfunctioning instruments are not to be used in the survey area, without specific authorization of the Project Health Physicist.
5.	PHP	**Visual Inspection of Instrument**—Assesses the significance of the damage and based on good health physics practices and determine if the instrument should not be used. Also provide information based on this determination to the RCT to be record in the "Remarks" section.
6.	RCT	**Visual Inspection of Instrument**—If the instrument is damaged and should not be used (i..e., based on discussion with the {PHP) indicate "N" in the Visual/Battery Check portion of the log and terminated this procedure. Document the damage in the "Remarks" section.
7.	RCT	**Battery Check--**The batteries in each meter shall be checked at the start of each work shift to ensure proper operation prior to being used in the survey area. Turn the meter on and allow several minutes for the instrument to "warm-up" and stabilize.
8.	RCT	**Battery Check--** Test the batteries to ensure that the unit is functional by turning the dial to the "BAT" position. The battery strength is indicated by the needle deflection.
9.	RCT	**Battery Check--** If the meter reading indicates that the batteries are good (e.g., needle deflection into the "BAT TEST" portion of the scale), enter "OK" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column.
10.	RCT	**Battery Check--** If the batteries are weak, turn off the meter and replace the weak batteries with new batteries. Recheck the meter in accordance with Paragraphs 7.04(b) through (d) to ensure that the new batteries are good. If the meter indicates that the batteries are good, enter "Replaced" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column to indicate that the batteries were replaced.
11.	RCT	**Battery Check--** If the meter indicates that the new batteries are not good, replace the batteries again and retest the meter. If the meter is still not functioning properly after trying two new sets of batteries, take the meter out of service and contact the Project Health Physicist. Enter "F" (Failed) on the Daily Operational Check Log (Exhibit 1) under the "Battery Check" column to indicate that the meter was taken out of service.
12.	RCT	Continue Procedure In Section 7.3, Background Check.

7.3 Background Check

1. RCT After completing the visual inspection and battery check (see Section 7.2), a background check shall be performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift background check should be completed.

2. RCT Background readings shall be measured in a low background area to verify proper instrument operation by measuring a consistent background radiation level, and to ensure that the detector is not contaminated. When practicable, the background area selected shall be similar to the conditions encountered in each survey area.

3. RCT All background checks shall be conducted at the same location to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials outside of the survey area, such as smears and air samples

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

- Turn on the instrument.
- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.
- The "F-S" toggle switch to the slow response "S" mode, if applicable.
- Press the speaker button "ON", if applicable.

5. RCT The detector face is to be orientated with the face down, consistent with Section 7.4. Ensure that all radiation sources are removed (at least 10 feet away) from the area during the background check.

6. RCT A ratemeter background is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

7. RCT Record the reading in ⊠rad/hr (or ⊠R/hr) on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column.

8. RCT Enter the background data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The background data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

9. RCT If this background data exceeds the allowed variation from the mean (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicates the instrument is beyond the acceptable tolerance for variability.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

10. RCT If the background reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column if at least 5 data points, widely separated in time, have been collected.

While the first 5 background values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of background through time, thus collection of several data point in a short time span does not provide useful data since the background variation is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

11. RCT If the background exceeds 2 standard deviations repeat steps 6 to 10 once, contact the PHP for instructions if the excess deviation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations criteria in step 10, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column. Also indicate the type of action (i.e., decontamination) that was taken for the recheck measurement.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

12. RCT If a source check is required proceed to Section 7.4.

13. RCT If a source check is not required complete return to the applicable section of this procedure.

7.4 Source Check

1. RCT After completing the background check (see Section 7.3), a source check is typically performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift source check should be completed. Obtain the source jig if it is not present from Section 7.3 activities.

2. RCT Source readings shall be measured in a low background area to verify proper instrument operation by measuring a consistent source plus background radiation level, and to ensure that the detector is not contaminated.

3. RCT When practicable source checks shall be conducted at the same location to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials, such as smears and air samples, outside of the survey area.

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

- Turn on the instrument.
- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.
- The "F-S" toggle switch to the slow response "S" mode, if applicable.
- Press the speaker button "ON", if applicable.

5. RCT Obtain the check source(s) for this instrument. Use the source #(s) on the Daily Operational Check Log, if the data is unavailable use the source(s) designated by the PHP.

6. RCT Carefully place the source on the table or floor surface

CAUTION: ***Do not contact the active surface of the sources*** **with your skin. This can result in unnecessary radiation exposure. These contact doses are typically significantly higher than generally expected by personnel. In addition, the chemical on the skin surface may damage the source invalidating its calibration and possibly causing the release of radioactive contamination.**

7. RCT Orient the detector face so it is facing the source at the fixed distance (normally 0.5 cm) and in the normal orientation. Ensure that all other radiation sources are removed (at least 10 feet away) from the area during the source check.

8. RCT A ratemeter source check is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

9. RCT Record the reading in ⊠rad/hr (or ⊠R/hr) on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column, then go to step 10.

10. RCT Enter the source check data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The source check data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

11. RCT If the source check data exceeds the allowed variation from the mean calculated in the control chart activities (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicate the instrument is beyond the acceptable tolerance for variability.

12. RCT If the source check reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 source check values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of the instrument performance through time, thus collection of several data point in a short time span does not provide useful data since the instrument performance is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

13. RCT If the source check value exceeds 2 standard deviations repeat steps 7 to 13 once, contact the PHP for instructions if this excess variation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations of the average for the control readings, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

14. RCT Describe any off-normal conditions that occurred during this process (this includes Sections 7.1 to 7.4 activities) in the "Remarks Column" and then initial entry.

15. RCT Return the source to the appropriate storage area.

16. RCT Record the data and time and initial the entry, then submit the datasheet to the FS.

17. FS Verify activity completion and initials after the RCT.

18. RCT Proceed to the applicable section for completion of data collection activities. At the termination of an activity or withdrawal of an instrument from usage arranges for transmission of the Daily Operational Check Log to the PHP for action and maintains a copy of this log in a manner consistent with the applicable Parsons/project records management procedure.

19. PHP Review the datasheet per Section 7.6, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

20. General The data on the datasheet should not be release to the client until Step 19 has been completed.

7.5 ⊠R Survey (i.e., Assess of Environmental Dose Rates)

Note: To implement this section the instrument used must be have a traceable calibration in ⊠rad/hr (or ⊠R/hr, although this is not recommended). This instrument will be used to determine if radiological the ambient radiation level in the area or associated with the item. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

1. RCT Verify that Sections 7.1 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity. Note, when implementing Sections 7.3 and 7.4 the data should be recorded in ⊠rad/hr (or ⊠R/hr, although this is not recommended).

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/Area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "N" to indicate that is a static count,
- If an alternative survey distance (i.e., typically 100 ± 5 cm) is required record this value in cm, and
- The count time indicated as "R".

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check to verify operations. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.1 to 7.4.

6. RCT Position the "F-S" toggle switch to the slow response **"F" (fast)** mode and ensure the speaker is on, if applicable.

7. RCT Hold the detector face or side at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

8. RCT Scan at a rate of 1 m every 1 to 6 seconds to give the instrument time to respond. Scan rates greater than 1 to 6 inches per second drastically reduce the probability of detection. The operator should listen to the audio output closely since it responds faster than the meter reading.

9. RCT For a static ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

10. RCT When surveying, any response above background should be investigated by holding the detector still to verify that the radiation rate is above background.

11. RCT If a reading above 1.25 times background or the action level provided by the PHP for this survey is confirmed, a static measurement should be taken in accordance with Section 7.3of this procedure.

12. RCT Continue scanning the entire surface within the designated area.

13. RCT If localized contamination is found the RCT may, decontaminate the surface per applicable Parsons procedure or other instructions provided by the Project Health Physicist.

14. RCT Resurvey the decontaminated areas per Steps 6 through 14.

15. RCT Record the scanning (i.e., highest reading in the area after any localized decontamination) and decontamination information on the Surface Radiation Field Measurement Data Sheet (see Exhibit 3).

16. RCT Repeat Steps 6 through 16 for each surface measurement location.

17. RCT Per direction of the PHP/FS or at the RCT discretion complete Sections 7.3 and/or 7.4 to re-verify instrument performance. This is often completed whenever there is a break in work activities.

18. RCT Record the total page count on each page and sign and date the datasheet, then submit the datatsheet to the FS.

19. FS Review and if completed properly, sign and date the datasheet, then stores this in-process record in accordance with applicable Parsons and project procedures and client requirements.

20. PHP Review the datasheet per Section 7.6, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

21. General The data on the datasheet should not be release to the client until Step 20 has been completed.

7.6 Data Verification

This is the initial step in the verification and validation of the data generated by this procedure, the final steps will be addressed by the verification and validation process described in the applicable workplan or similar document.

1. HP On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibit 1) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).

2. HP Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.

3. HP Review the data for the following technical considerations:

- Are the data technical consistent,
- Are the calibrations of the instrument current, valid for the intended use, and of sufficient accuracy for the intended use,
- Were appropriate and current calibration and check sources used,
- Is there appropriate documentation for all calibrations (e.g., meters, detectors, and sources) in the records,
- Are the background values credible and are the background data consistent with the statistical variability expected,
- Is the expected level of background radiation present,
- Have appropriate backgrounds data set been obtained,
- Is there consistency between these values and the other survey data,
- Are the radiation types and radionuclides present in credible relative ratios,
- Is additional count time required to meet data quality objectives,
- Does the equipment appear to be functioning properly,
- Were any technical concerns/inconsistencies appropriately followed up on and resolved, and
- Are there any other outstanding technical, operational, or quality issues associated with the data.

4. HP If there are problems or potential problems associated the data, the HP initiates the any designated SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.

5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.

6. HP Documents the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification.

7. HP Once the datasheet is completed and any applicable NCRs are generated, signs and dates the Datasheets as verified (i.e., verified pending resolution of outstanding NCRs) and stores the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure.

8.0 RECORDS

Exhibits 1 and 3 with any associated attachments and applicable associated NCRs are the quality records generated by this procedure.

Exhibit 1

PARSONS	Daily Operational Check Log Instrument #____________	SOP-R.SUR-1-1 -________ Page ___ of ___ Revision 0 Last Date Calibrated: __________ Calibration Due Date: __________

Project Title: ______________________ Project Number: ______________________ Prepared By Print: ______________________ Prepared By Signature:______________ Date: ________ Verified By Signature:______________ Date: ________	Meter Make/Model: ______________ Meter Serial No.: ______________ Detector Make/Model:______________ Detector Serial No.: ______________	(optional data enter as needed) Isotope: _____ Efficiency: _____ Isotope: _____ Efficiency: _____ Isotope: _____ Efficiency: _____ Isotope: _____ Efficiency: _____ Channel 1 Window: ______ to _______ (keV) Channel 2 Window: ______ to _______ (keV)

Voltage Consistent With Calibration Certificate			No	Acceptable Background Range		Acceptable Source Check Range	

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (___-minute Scalar)	Remarks	Pass/ Fail		

Exhibit 1 (Continued)

PARSONS

Daily Operational Check Log (Continuation Sheet) Instrument #_____________

SOP-R.SUR-1-1 -_____________ Page __ of __
Revision 0

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (_____-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (_____-minute Scalar)	Source #	Pass/ Fail		

Exhibit 2

Example of a Control Chart

Parameter Being Tracked Cs-137 0.661 MeV peak counts, post fine tuning

Electectronics

Instrument Type	URSA-MCA
Model Number	Universal Radiation Spectrum Analyzer
Manufacturer	RSA
Serial Number	20291

Detector

Instrument Type	Fidler
Model Number	M-23
Manufacturer	Ortec
Serial Number	X-111
Geometry	Center Line Area Source at 4"
ROI	Cs-137 0.661 MeV peak

Count Data

Mean= 897.1667

STDEV= 71.46025

Date/Time	Data Number	Data	Pull Block	Status
1/1/00 0:00	1	905	[redacted]	[redacted]
1/5/00 0:00	3	1001	[redacted]	[redacted]
1/6/00 0:00	4	787	[redacted]	[redacted]
1/7/00 0:00	5	923	[redacted]	[redacted]
1/10/00 0:00	6	911	[redacted]	OK
1/2/00 0:00	2	856	[redacted]	[redacted]

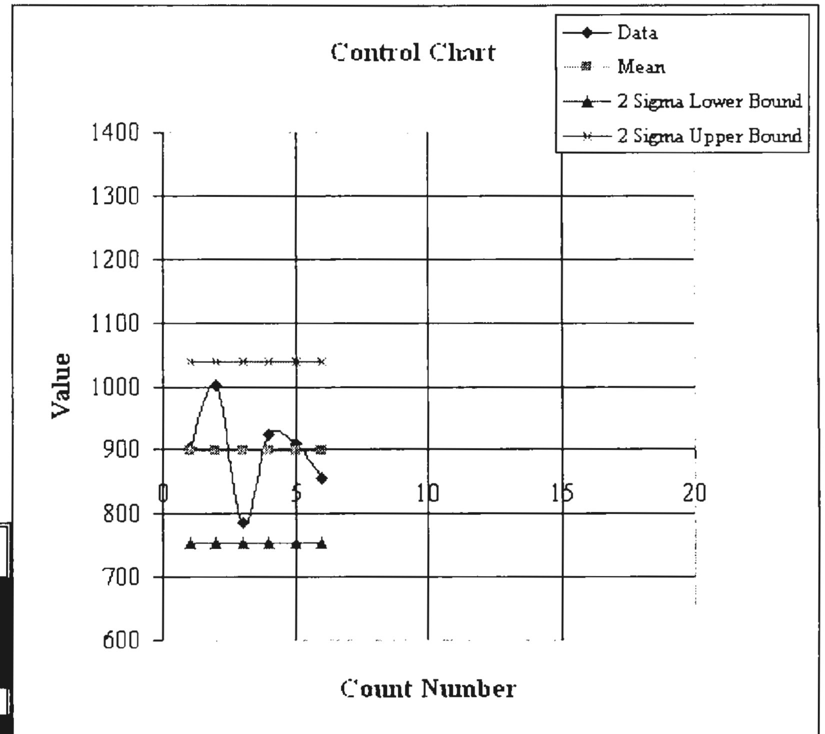


Exhibit 3

PARSONS

Surface Radiation
Field Measurement Datasheet

SOP-R-SUR-1-2- __________ Revision 0
Page ___ of ___ Date: _______

Project Title: ____________________
Project Number: ____________________
Building/area/Floor: ____________________
Room/unit Designation: ____________________

Surveyor (print): __________ Surveyor Signature: __________ Date: ______
Verifier (print): __________ Verifier Signature: __________ Date: ______
Complete FS (print): __________ FS Signature: __________ Date: ______

Measurement Location		Direct Surface Reading static (Y/N) Type ______ Count Time (M) ______			Direct Surface Reading static (Y/N) Type ______ Count Time (M) ______			Alt. Distance (optional) ______ cm (left instr) Alt. Distance (optional) ______ cm (right instr)
No	Per Reference Map	Value (______)	Channel (optional)	Instr. #	Value (______)	Channel (optional)	Instr. #	Remarks
Instr. Check Source								

Specialized Geometry (optional):

Exhibit 3 (continued)

PARSONS — Surface Radiation Field Measurement Datasheet (continued) — SOP-R-SUR-1-2- __________ Revision 0 — Page ___ of ___ — Date: __________

Measurement Location		Direct Surface Reading			Direct Surface Reading			Remarks
No	Per Reference Map	Value (________)	Channel (optional)	Instr. #	Value (________)	Channel (optional)	Instr. #	

Table of Contents

1.0 PURPOSE

This procedure provides the requirements for measuring direct photon (gamma or x-ray) volume or surface activity using a ratemeter or scalar with a FIDLER scintillation detector (e.g., NaI detector). The FIDLER is a thin large surface area crystal designed to improve the performance in assessing low energy photon flux (particularly the 60 keV peak associate with Am-241) by increasing the area of the surface face while reducing the volume of the detector. The purpose of this procedure is to institute daily operational checks and to standardize the operation of the photon survey instrument to ensure that quality field measurements are obtained.

2.0 SCOPE

This procedure is applicable to a FIDLER NaI crystal with a Bircon Analyst meter or equivalent instruments specifically designated by the PHP or in the work plan or equivalent document. This instrument will be used to quantify low energy photon emissions from radiological contamination (photon-emitting radioisotopes) that may be present on the surfaces or within the matrix of floors, walls, soils, or equipment. This detector is effect from a few keV to a few hundred keV, outside of this range the larger volume scintillations detectors addressed by SOP-R-SUR-002 provide more accurate measurements. These direct surface measurements are taken prior to collecting a smear sample for surface surveys to ensure a representative assessment of the total (e.g., fixed plus removable) contamination levels. This instrument is also used to screen samples (e.g., smears, soils, etc.) to determine if radiological contamination is present and maybe used for radionuclide identification as described in SOP-R-MCA-002.

This procedure is applicable to the collection of photon emission data, unrelated to energy of the emission, and exposure rate data within the limitations of the response of the detector. This equipment maybe used to support decommissioning and/or impact assessment data collection under the requirements of the DOE, NRC, or EPA. This procedure maybe applied to other activities at the discretion of the Project Manager. This procedure can only be implemented by trained and qualified personnel.

3.0 REFERENCES

1. NRC, 1997. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Final, December 1997.

2. QA-15.0, *Quality Assurance Procedure, Nonconformance Control, Quality Assurance Manual,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

3. SOP-R-MCA-001, *GM Pancake Probe Surveys and Static Counts for Beta and Photon Activity for Environmental Investigations and Personnel Protection,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

4. SOP-R-MCA-002, *Gamma Spectroscopy Instrument Operation,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

5. SOP-R-SUR-001, *GM Pancake Probe Surveys and Static Counts for Beta and Photon Activity for Environmental Investigations and Personnel Protection,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

6. SOP-R-SUR-002, *Photon (Gamma and X-Ray) Survey Using Scintillators for Environmental Investigations and Personnel Protection*, Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

7. SOP-R-SUR-004, *Collection, Handling, and Analysis of General Smear Samples for Environmental Investigations,* Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

4.0 DEFINITIONS

1. **Channel** refer to the setting (i.e., channel 1 or 2) on the FIDLER to select a window that was preset during the calibration process.

2. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.
   - The materials associated with the radiation source and any associate container including back-scatter surfaces.

3. **Mutichannel Analyzer (MCA)** is an instrument with the capability of collection of radiation flux data as a function of radiation energy when attached to a suitable detector. These instruments typically have associate hardware/software for the identification of radionuclides in addition to the assessment of detected flux.

4. **Out** refers to the FIDLER setting that extends the window over the entire range of the FIDLER, in other words eliminates the window.

5. **Ratemeter** is an electronic devices that sums pulse received from a detector over a set time period (typically very short) and displays this count in the form of equivalent counts per minute (cpm).

6. **Single-channel Analyzer (SCA)** is an instrument or an instrument circuit with the capability of collection of radiation flux data, which is greater than or less than the preset of radiation energy when attached to a suitable detector.

7. **Scalar** is similar to a ratemeter but this instrument counts the pulse for a time period, typically set by the operator, and displays the total counts for this time period.

8. **Scintillation detector** is a detector that is used to detect the presence of photon (i.e., gamma or x-ray) radiation. A scintillation detector typically consists of two components the scintillation material and a photomultiplier tube (or photodiode) in a single sealed light tight package. The scintillator produces a light pulse when it absorbs a photon, whose intensity is typically proportional to the energy of the photon. The photomultiplier tube (or photodiode) detects this pulse, multiplies its, and turns it into an electrical pulse that can be interpreted by a multichannel analyzer, ratemeter, scalar, or other counting system.

9. **Survey Area** is an area where radioactive materials or contamination are or may be present. Survey areas include areas where samples/smears (which may contain radioactivity) are being screened.

10. **Window** is a set of energy bound set into the instrument during calibration, which limits the collection of counts to photons within the energy bounds of the window. These windows are established with an upper and lower bound SCA.

5.0 GENERAL REQUIREMENTS AND LIMITATIONS

1. Use a FIDLER detector and associated ratemeter/scalar instrument system with in the set channel or without a set channel as specifically authorized by the PHP and/or identified in the work plan or equivalent document. The channel are preset as part of the calibration process using SCA's to collect counts in specific energy bands. There are 2 channels available with the FIDLER which will have the preset energy bands identified in the calibration certificate.

2. The survey requirement will be established by the work plan, safety plan, and/or equivalent documents for the project or specifically provided by the PHP.

3. Only qualified and trained personnel are allowed to implement this procedure.

4. A background determination and instrument Operational check in accordance with this procedure shall be performed prior to the first use of the instrument on each shift.

5. The instrument shall be fully functional prior to using in the survey area.

6. If the instrument appears to have failed during use in the survey area, then leave the survey area immediately.

7. **NEVER ADJUST THE CALIBRATION CONTROLS OR THE CHANNEL BOUNDARIES.**

8. The count ratemeter/scalar, cable, and detector are calibrated as a unit and may not be interchanged without recalibration.

6.0 RESPONSIBILITIES

6.1 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the selection and survey requirements are consistent with the technical requirements of this procedure, the regulations, applicable project documentation, and good health physics practices.

2. Training the Radiological Control Technician (RCT) in the proper use of this procedure.

3. Providing independent review of the documentation and data to ensure it is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.

4. Ensuring that the instruments are properly maintained and calibrated at specified intervals.

5. Training the RCTs in the proper use of this instrument.

6. Identification and specification of equivalent instrumentation to be used with this procedure.

7. Reviewing the instrument field test and measurement data to ensure that the data is consistent and credible, and following up on data anomalies.

6.2 Radiological Control Technicians (RCT) are responsible for:

1. Implementing this procedure and the applicable training.

2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.

3. Reporting out of specification conditions to the Project Health Physicist and/or Field Supervisor.

4. Operating this instrument in accordance with this procedure and the applicable training.

5. Maintaining daily Operational check records for each instrument.

6. Documenting data collected using the instrument in accordance with appropriate regulations and procedures.

7. Reporting instrument malfunctions to the Project Health Physicist.

6.3 Project Manager (PM) (or designee, such as the field supervisor)

1. Provides required materials and trained/qualified personnel for implementation of the task.

2. Provides operational review of the project specific activities for these data collection activities.

3. Determines the applicability of this procedure beyond the areas specifically identified in Section 2.0.

6.4 Field Supervisor (FS)

1. PM site representative and responsible for routine supervision of the task.

2. Verifies completion of the task.

7.0 PROCEDURES

Note: When surveying the detection of increases in activity can be more effectively identified by the audible sound than by monitoring the meter movement or digital display. Use the sound to locate the activity and the meter or display to assess the count rate or counts if available with the instrumentation.

Note: If at anytime during this procedure there are conditions that may impact the results note this information in the comment section or on the back of the applicable datasheet.

Note: This procedure is for using low energy photon scintillation measurement equipment specifically authorized by the PHP and/or the work plan or equivalent document.

Note: Exhibits 1, 2 and 3 are typical examples, but the current version of these datasheets are maintained in SOP-R-SUR-001.

Note: Radioactive decay is a statistical phenomena and rates the radiation emission rate will fluctuate significantly. In estimating count rates, the central tendency of the count rate (e.g., meter position) and not the upper or lower bound is relevant. It addition, in addressing survey activities, the background radiation from natural and unrelated man-enhanced radiation (e.g., fallout, some welding rods, exit signs, smoke detectors) typically changes significantly as a function of location due to changes in materials present. It is important to recognize that soils, rocks, concrete, blocks, and ceramics typically have significant levels of ambient background associated with them and care should be exercised to not miss-identify these materials as contaminated when only ambient background is present.

Note: If this activity involves a trainee then both the trainee and the RCT performing the on-the-job training print/initial/sign their names.

7.1 Prerequisite Actions

Note: It is acceptable to add attachments containing the information to the Daily Operational Check Log (Exhibit 1) and then reference these attachments (i.e., attachments are not included in the datasheet page count but are number separately) on the datasheet. In addition the Daily Operational Check Log maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

1.	PHP	Reviews the work plan, site data, regulatory requirements, customer requirements, and other applicable documentation with the PM and establishes the appropriate survey requirements, equivalent instrumentation, windows for the equipment, count times, and action levels for implementing this procedure.
2.	PHP	Arrange for the calibration of the FIDLER with the proper windows needed for the intended survey.
3.	FS/ PHP	Directs initiation of the survey activity in accordance with this procedure.
4.	PHP	Provide the RCT with the data identified in steps 1 and 5.
5.	RCT	Ensure that meter and detector match the calibration certificate prior to operating. • Assign an unique meter number to the instrument, which does not have one. • Attach an identifying label to the side of the meter, which does not have one. Record the meter number, meter and detector serial numbers, and calibration information on the Survey Instrument Log.
6.	RCT	If missing, record the following information on the Daily Operational Check Log (Exhibit 1) prior to using the instrument. A separate log needs to be maintained for each instrument used. • Project Title and Number, • Meter Make/Model and Serial Number, • Detector Make/Model and Serial Number, • Last Date Calibrated, • Calibration Due Date, • Applicable units for background and source counts (typically cpm, counts, or ⊠rad/hr), • Record the window information from the calibration certificate for channels 1 and 2, • Applicable count time if scalar counts (0.1, 1, or 10 minutes) are made or an R for ratemeter readings, and • Isotope-specific instrument efficiencies based on current calibration.
7.	RCT	If the meter or detector is due for calibration, it must be tagged "Calibration Due" and given to the Project Health Physicist (or Field Supervisor if Project HP is unavailable). Instruments requiring calibration shall not be used for taking radiation measurements in survey areas.
8.	RCT	Check the high voltage setting and ensure that it is set as recommended on the appropriate meter calibration certificate. If the voltage is not properly set, contact the Project Health Physicist for further direction.
9.	RCT	Document these activities on the operational Daily Operational Check Log.

10. RCT Records the Background and Source Check count time for "Scalar" mode on the datasheet. If the instrument has no scalar mode record an "R" on these lines.

11. PHP Reviews the datasheet routinely and once it is completed per Section 7.8. Once the datasheet is completed and any data anomalies have been resolved signs and dates the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

12. General The data on the datasheet should not be release to the client until Step 11 has been completed.

7.2 Operational Checks

Note: This section of the procedure maybe implemented in conjunction with the sampling/survey activity. It is acceptable to add attachments containing the information to the Sampling/Survey Grid Datasheet and then reference these attachments on the datasheet. The attachments are separately numbered and not part of the Datasheet page numbering.

1. RCT **Visual Inspection of Instrument--** Each instrument shall be inspected at the start of each work shift to identify potential problems or damage prior to being used in the survey area.

2. RCT **Visual Inspection of Instrument--** The date and time of this check and the name of the person performing the check shall be recorded on the Daily Operational Check Log (Exhibit 1) that corresponds to the meter/detector serial numbers in conjunction with documentation of the other activities in this section.

3. RCT **Visual Inspection of Instrument--** Visually check the instrument for signs of physical damage (e.g., broken or loose cables; missing screws or other parts; and inoperable switches or knobs) and ensure that the calibration due date has not passed.

4. RCT **Visual Inspection of Instrument--** Report any damage or other problems (not already documented on the log) to the Project Health Physicist to determine if the equipment can still be used. Malfunctioning instruments are not to be used in the survey area, without specific authorization of the Project Health Physicist.

5. PHP **Visual Inspection of Instrument—**Assesses the significance of the damage and based on good health physics practices determines if the instrument should not be used. Also provide information based on this determination to the RCT to be record in the "Remarks" section.

6. RCT **Visual Inspection of Instrument—**If the instrument is damage and should not be used (i..e., based on discussion with the {PHP) indicate "N" in the Visual/Battery Check portion of the log and terminated this procedure. Document the damage in the "Remarks" section.

7. RCT **Visual Inspection of Instrument**—If the scalar count time is not "R" open the case and verify the circuit board switch is set to the indicated count time (i.e., 0.1, 1, or 10 minutes per datasheet). If it is not set it to the indicated count time correct the switch and document the adjustment in the "Remarks" column. Close the instrument case.

8. RCT **Battery Check--**The batteries in each meter shall be checked at the start of each work shift to ensure proper operation prior to being used in the survey area. Turn the meter on and allow several minutes for the instrument to "warm-up" and stabilize.

9. RCT **Battery Check--** Test the batteries to ensure that the unit is functional by turning the dial to the "BAT" position. The battery strength is indicated by the needle deflection.

10. RCT **Battery Check--** If the meter reading indicates that the batteries are good (e.g., needle deflection into the "BAT TEST" portion of the scale), enter "OK" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column.

11. RCT **Battery Check--** If the batteries are weak, turn off the meter and replace the weak batteries with new batteries. Recheck the meter in accordance with Steps 8 through 11 to ensure that the new batteries are good. If the meter indicates that the batteries are good, enter "Replaced" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column to indicate that the batteries were replaced.

12. RCT **Battery Check--** If the meter indicates that the new batteries are not good, replace the batteries again and retest the meter. If the meter is still not functioning properly after trying two new sets of batteries, take the meter out of service and contact the Project Health Physicist. Enter "F" (Failed) on the Daily Operational Check Log (Exhibit 1) under the "Battery Check" column to indicate that the meter was taken out of service.

13. RCT Continue Procedure In Section 7.3, Background Check.

7.3 Background Check

Note: If readings with the various window (out, in channel 1, and/or channel 2) positions are being used in this survey, the set of readings can be completed jointly by switching between each setting and documenting the results separately or in the remarks column.

1. RCT After completing the visual inspection and battery check (see Section 7.2), a background check shall be performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift background check should be completed.

2. RCT Background readings shall be measured in a low background area to verify proper instrument operation by measuring a consistent background radiation level, and to ensure that the detector is not contaminated. When practicable, the

background area selected shall be similar to the conditions encountered in each survey area. Obtain the source count jig.

3. RCT All background checks shall be conducted at the same location and in the source count jig to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials outside of the survey area, such as smears and air samples.

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

- Turn on the instrument.
- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.
- The "F-S" toggle switch to the slow response "S" mode, if applicable.
- Set to the Channel 1, 2, or "Out" position, as appropriate.
- Press the speaker button "ON", if applicable.

Note: It is acceptable to switch between Channel 1, 2, or "Out" position, as appropriate, to collect the required data during this counting process.

5. RCT The detector face is to be orientated in the source count jig with the face down, consistent with Section 7.4. Ensure that all radiation sources are removed (at least 10 feet away) from the area during the background check.

6. RCT If a ratemeter background is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

7. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column and go to step 10.

8. RCT If the scalar mode data is to be collected (i.e., a count time is specified), initiate the scalar count.

9. RCT Record the reading in counts or cpm on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column for either the Channel 1, Channel 2, and/or "Out" window settings, as appropriate.

10. RCT Enter the background data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The background data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

11. RCT If this background data exceeds the allowed variation from the mean (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicates the instrument is beyond the acceptable tolerance for variability.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

12. RCT If the background reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 background values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of background through time, thus collection of several data point in a short time span does not provide useful data since the background is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

13. RCT If the background exceeds 2 standard deviations repeat steps 6 to 13 once, contact the PHP for instructions if the excess deviation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations criteria from step 12, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column. Also indicate the type of action (i.e., decontamination) that was taken for the recheck measurement.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

14. RCT If a source check is required proceed to Section 7.4.

15. RCT If a source check is not required complete return to the applicable section of this procedure.

7.4 Source Check

Note: If readings with the various window (out, in channel 1, and/or channel 2) positions are being used in this survey, the set of readings can be completed jointly by switching between each setting and documenting the results separately or in the remarks column.

1. RCT After completing the background check (see Section 7.3), a source check is typically performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift source check should be completed. Obtain the source jig if it is not present from Section 7.3 activities.

2. RCT Source readings shall be measured in a low background area in the source jig to verify proper instrument operation by measuring a consistent source plus background radiation level, and to ensure that the detector is not contaminated.

3. RCT When practicable source checks shall be conducted at the same location to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials, such as smears and air samples, outside of the survey area.

4. RCT Ensure that the meter is on and properly "warmed-up" and set to:

- Turn on the instrument.
- The appropriate multiplier dial to the appropriate scale for the background activity (typically X1) if not a digital output.
- The "F-S" toggle switch to the slow response "S" mode, if applicable.
- Set to the Channel 1, 2, or "Out" position, as appropriate.
- Press the speaker button "ON", if applicable.

Note: It is acceptable to switch between Channel 1, 2, or "Out" position, as appropriate, to collect the required data during this counting process.

5. RCT Obtain the check source(s) for this instrument. Use the source #(s) on the Daily Operational Check Log, if the data is unavailable use the source(s) designated by the PHP.

6. RCT Carefully place the source in the jig facing up.

CAUTION: ***Do not contact the active surface of the sources* with your skin. This can result in unnecessary radiation exposure. These contact doses are typically significantly higher than generally expected by personnel. In addition, the chemical on the skin surface may damage the source invalidating its calibration and possibly causing the release of radioactive contamination.**

7. RCT Orient the detector face so it is facing the source at the fixed distance and in the fixed orientation established by the jig. Ensure that all other radiation sources are removed (at least 10 feet away) from the area during the source check.

8. RCT If a ratemeter source check is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

9. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column, then go to step 12.

10. RCT If the scalar mode data is to be collected (i.e., a count time is specified), initiate the scalar count.

11. RCT Record the reading in counts or cpm on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column.

12. RCT Enter the source check data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The source check data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

13. RCT If the source check data exceeds the allowed variation from the mean calculated in the control chart activities (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicate the instrument is beyond the acceptable tolerance for variability.

14. RCT If the source check reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 source check values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of the instrument performance through time, thus collection of several data point in a short time span does not provide useful data since the instrument performance is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

15. RCT If the source check value exceeds 2 standard deviations repeat steps 7 to 15 once, contact the PHP for instructions if this excess variation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations of the average for the control readings, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

16. RCT Describe any off-normal conditions that occurred during this process (this includes Sections 7.1 to 7.4 activities) in the "Remarks Column" and then initial entry.

17. RCT Return the source to the appropriate storage area.

18. RCT Record the data and time and initial the entry, then submit the datasheet to the FS.

19. FS Verify activity completion and initials after the RCT.

20. RCT Proceed to the applicable section for completion of data collection activities. At the termination of an activity or withdrawal of an instrument from usage arranges for transmission of the Daily Operational Check Log to the PHP for action and maintains a copy of this log in a manner consistent with the applicable Parsons/project records management procedure.

21. PHP Review the datasheet per Section 0, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

22. General The data on the datasheet should not be release to the client until Step 21 has been completed.

7.5 Survey of Surfaces or Items

Note: This instrument will be used to determine if radiological contamination (photon-emitting radioisotopes) are present on the volume or surfaces of floors, walls, soils, or equipment. These direct measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: If readings with the various window (out, in channel 1, and/or channel 2) positions are being used in this survey, the set of readings can be completed jointly by switching between each setting and documenting the results separately or in the remarks column.

Note: This survey maybe conducted in simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

1. RCT Verify that Sections 7.1 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "N" to indicate that is a static count,
- Record the Channel 1, 2, or "Out" position, as appropriate.
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and
- The count time indicated as "R".

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT Set to the Channel 1, 2, or "Out" position, as appropriate.

Note: It is acceptable to switch between Channel 1, 2, or "Out" position, as appropriate, to collect the required data during this counting process.

6. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check to verify operations. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.1 to 7.4.

7. RCT Position the "F-S" toggle switch to the fast response **"F" (fast)** mode and ensure the speaker is on, if applicable.

8. RCT Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

9. RCT Scan at a rate of 1 to 6 inch every 2 seconds to give the instrument time to respond. The operator should listen to the audio output closely since it responds faster than the meter reading.

10. RCT A ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

11. RCT If the reading exceeds 10,000 dpm/100 cm^2 (167 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required.

12. RCT When surveying, any response above background should be investigated by holding the detector still to verify that the radiation rate is above background.

13. RCT If a reading above 1.25 times background or the action level provided by the PHP for this survey is confirmed, a static measurement should be taken in accordance with Section 7.6 of this procedure.

14. RCT Continue scanning the entire surface within the designated area.

15. RCT If localized contamination is found the RCT may, decontaminate the surface per applicable Parsons procedure or other instructions provided by the Project Health Physicist.

16. RCT Resurvey the decontaminated areas per Steps 8 through 16.

17. RCT Record the scanning (i.e., highest reading in the area after any localized decontamination), the channel, and decontamination information on the Surface Radiation Field Measurement Data Sheet (see Exhibit 3).

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

18. RCT Repeat Steps 9 through 18 for each surface measurement location.

19. RCT Per direction of the PHP/FS or at the RCT discretion complete Sections 7.3 and/or 7.4 to re-verify instrument performance. This is often completed whenever there is a break in work activities.

20. RCT Record the total page count on each page and sign and date the datasheet, then submit the datatsheet to the FS.

21. FS Review and if completed properly, sign and date the datasheet, then stores this in-process record in accordance with applicable Parsons and project procedures and client requirements.

22. PHP Review the datasheet per Section 7.8, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

23. General The data on the datasheet should not be release to the client until Step 22 has been completed.

7.6 Field Static Counts

Note: This instrument will be used to determine if radiological contamination (photon-emitting radioisotopes) are present on the volumes or surfaces of floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: If readings with the various window (out, in channel 1, and/or channel 2) positions are being used in this survey, the set of readings can be completed jointly by switching between each setting and documenting the results separately or in the remarks column.

Note: This survey maybe conducted in simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

1. RCT Verify that Sections 7.1 to 7.4 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- Record Channel 1, 2, or "Out" position, as appropriate.
- A "Y" or "N" to indicate if this is a static count,
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and

The count time in minutes, indicate "R" in this space if the survey is being made in ratemeter mode.

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT Set to Channel 1, Channel 2, or "Out", as appropriate.

Note: It is acceptable to switch between Channel 1, 2, or "Out" position, as appropriate, to collect the required data during this counting process.

6. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check to verify operations. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.1 to 7.4.

7. RCT Position the "F-S" toggle switch to the fast response **"F" (fast)** mode and ensure the speaker is on, if applicable.

8. RCT Per direction of the PHP/FS or at the RCT discretion complete Sections 7.3 and/or 7.4 to re-verify instrument performance. This is often completed whenever there is a break in work activities.

9. RCT Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

10. RCT If this is a scalar mode measurement initiate a scalar count or if a ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

11. RCT If the reading exceeds 10,000 dpm/100 cm^2 (167 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required.

12. RCT Record the reading in cpm on the Surface Radiation Field Measurement Data Sheet (Exhibit 3). The location of the measurement and window is also to be recorded on the Data Sheet.

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

13. RCT Repeat Steps 9 through 13 for each location.

14. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

15. FS Review and if completed properly, sign and date the datasheet, then stores this in-process record in accordance with applicable Parsons and project procedures and client requirements.

16. PHP Review the datasheet per Section 7.8, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

17. General The data on the datasheet should not be release to the client until Step 16 has been completed.

7.7 Counting of Smear, Air Samples, and Other Materials

CAUTION: Smears, samples, and equipment should be handled as potentially contaminated material during this process.

Note: If readings with the various window (out, in channel 1, and/or channel 2) positions are being used in this survey, the set of readings can be completed jointly by switching between each setting and documenting the results separately or in the remarks column.

1.	PHP	Specify the appropriate counting system geometry and sources for used in calibrating/source checking this configuration and provide this information to the RCT.
2.	RCT	Obtains the counting jig/configuration system and sources specified by the PHP.
3.	RCT	Verify that Sections 7.1 through 7.4 have been completed for the instrument.
4.	RCT	Complete a background count for the counting jig/configuration per Section 7.3, being sure to use the control charts and actions level for this specific geometry for the instrument and not the general geometry for the instrument.
5.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the Surface Radiation Field Measurement Datasheet used to record this data, which is a possible reference.)
6.	RCT	Complete a source count for the each source designated by the PHP for the counting jig/configuration per Section 7.4, being sure to use the control charts and actions level for this specific geometry for the instrument and not the general geometry for the instrument.
7.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the "Surface Radiation Field Measurement Datasheet" used to record this data, which is a possible reference.)
8.	RCT	Return the source to the appropriate storage area.
9.	RCT	Place the sample in a jig or other container to establish the fixed geometry specified by the PHP
10.	RCT	Perform the static count of the samples in accordance with Section 7.6 in a low background area. The sample number used in the count are the location. The samples are to be counted in the jig.
11.	RCT	Document the geometry for these counts in the "Specific Geometry" section of the Surface Radiation Field Measurement Datasheet.
12.	RCT	Samples should be handled as potentially contaminated material after counting.

7.8 Data Verification

This is the initial step in the verification and validation of the data generated by this procedure, the final steps will be addressed by the verification and validation process describe in the applicable workplan or similar document.

1. HP On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibit 1) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).
2. HP Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.
3. HP Review the data for the following technical considerations:
   - Are the data technical consistent,
   - Are the calibrations of the instrument current, valid for the intended use, and of sufficient accuracy for the intended use,
   - Were appropriate and current calibration and check sources used,
   - Is there appropriate documentation for all calibrations (e.g., meters, detectors, and sources) in the records,
   - Are the background values credible and are the background data consistent with the statistical variability expected,
   - Is the expected level of background radiation present,
   - Have appropriate backgrounds data set been obtained,
   - Is there consistency between these values and the other survey data,
   - Are the radiation types and radionuclides present in credible relative ratios,
   - Is additional count time required to meet data quality objectives,
   - Does the equipment appear to be functioning properly,
   - Were any technical concerns/inconsistencies appropriately followed up on and resolved, and
   - Are there any other outstanding technical, operational, or quality issues associated with the data.
4. HP If there are problems or potential problems associated the data, the HP initiates the any designated SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.
5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.
6. HP Documents the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification.

7. HP Once the datasheet is completed and any applicable NCRs are generated, signs and dates the Datasheets as verified (i.e., verified pending resolution of outstanding NCRs) and stores the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure.

8.0 RECORDS

Exhibits 1 and 3 and any associated attachments and any applicable associated NCRs are the quality records generated by this procedure.

Exhibit 1

PARSONS	Daily Operational Check Log Instrument #____________	SOP-R.SUR-1-1 -____________ Page __ of __ Revision 0 Last Date Calibrated: __________ Calibration Due Date: __________
Project Title: ____________________ Project Number: ____________________ Prepared By Print: ____________________ Prepared By Signature:______________ Date: ________ Verified By Signature: ______________ Date: ________	Meter Make/Model: ________ Meter Serial No.: ________ Detector Make/Model:________ Detector Serial No.: ________	(optional data enter as needed) Isotope: _____ Efficiency: _____ Isotope: _____ Efficiency: _____ Isotope: _____ Efficiency: _____ Isotope: _____ Efficiency: _____ Channel 1 Window: ______ to _______ (keV) Channel 2 Window: ______ to _______ (keV)

Voltage Consistent With Calibration Certificate			No	Acceptable Background Range		Acceptable Source Check Range	

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (___-minute Scalar)	Source #	Pass/ Fail		

Exhibit 1 (Continued)

PARSONS

Daily Operational Check Log (Continuation Sheet)
Instrument #____________

SOP-R.SUR-1-1 -____________ Page __ of __
Revision 0

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (___-minute Scalar)	Source #	Pass/ Fail		

Exhibit 2
Example of a Control Chart

Parameter Being Tracked Cs-137 0.661 MeV peak counts, post fine tuning

Electectronics

Instrument Type	URSA-MCA
Model Number	Universal Radiation Spectrum Analyzer
Manufacturer	RSA
Serial Number	20291

Detector

Instrument Type	Fidler
Model Number	M-23
Manufacturer	Ortec
Serial Number	X-111
Geometry	Center Line Area Source at 4"
ROI	Cs-137 0.661 MeV peak

Count Data

Mean= 897.1667

STDEV= 71.46025

Date/Time	Data Number	Data	Pull Block	Status
1/1/00 0:00	1	905	[redacted]	[redacted]
1/5/00 0:00	3	1001	[redacted]	[redacted]
1/6/00 0:00	4	787	[redacted]	[redacted]
1/7/00 0:00	5	923	[redacted]	[redacted]
1/10/00 0:00	6	911	[redacted]	OK
1/2/00 0:00	2	856	[redacted]	[redacted]

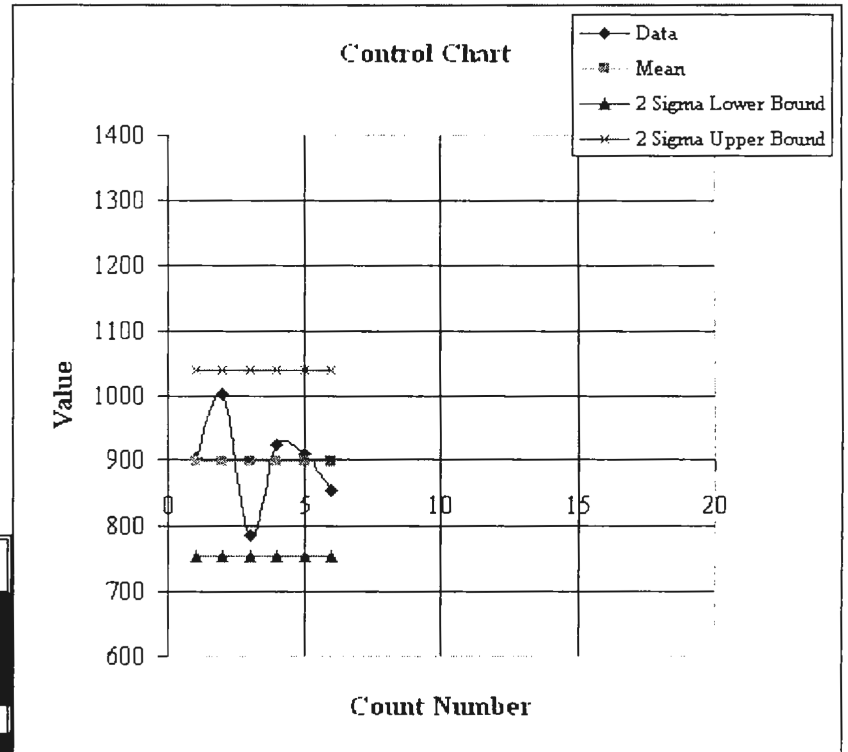


Exhibit 3

PARSONS

Surface Radiation
Field Measurement Datasheet

SOP-R-SUR-1-2- ____________ Revision 0
Page ___ of ___ Date: ____________

Project Title: ____________ Surveyor (print): ____________ Surveyor Signature: ____________ Date: ______
Project Number: ____________
Building/area/Floor: ____________ Verifier (print): ____________ Verifier Signature: ____________ Date: ______
Room/unit Designation: ____________
Complete FS (print): ____________ FS Signature: ____________ Date: ______

Measurement Location		Direct Surface Reading static (Y/N) ☐ Type ________ Count Time (M) ______			Direct Surface Reading static (Y/N) ☐ Type ________ Count Time (M) ______			Alt. Distance (optional) ________cm (left instr) Alt. Distance (optional) ________cm (right instr)
No	Per Reference Map	Value (__________)	Channel (optional)	Instr. #	Value (__________)	Channel (optional)	Instr. #	Remarks
Instr. Check Source								

Specialized Geometry (optional):

Exhibit 3 (continued)

PARSONS	Surface Radiation Field Measurement Datasheet (continued)	SOP-R-SUR-1-2- ________ Page ___ of ___	Revision 0 Date: ________

Measurement Location		Direct Surface Reading			Direct Surface Reading			Remarks
No	Per Reference Map	Value (________)	Channel (optional)	Instr. #	Value (________)	Channel (optional)	Instr. #	

1. PURPOSE

This procedure provides the requirements for measuring direct alpha surface activity using a ratemeter or scalar with a ZnS scintillation detector. The purpose of this procedure is to institute daily operational checks and to standardize the operation of the alpha survey instrument to ensure that quality field measurements are obtained.

2. SCOPE

This instrument will be used to quantify radiological contamination (alpha-emitting radioisotopes) that may be present on the surfaces of floors, walls, soils, or equipment. These direct surface measurements are taken prior to collecting a smear sample to be representative of total (e.g., fixed plus removable) contamination levels. This instrument is also used to screen samples (e.g., smears, soils, etc.) to determine if radiological contamination is present.This procedure is applicable to the collection of alpha emission data, unrelated to energy of the emission, within the limitations of the response of the detector. This equipment maybe used to support decommissioning and/or impact assessment data collection under the requirements of the DOE, NRC, or EPA. This procedure maybe applied to other activities at the discretion of the Project Manager. This procedure can only be implemented by trained and qualified personnel.

3. REFERENCES

1. NRC, 1997. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Final, December 1997.

2. *Instruction Manual Ludlum Model 2241 Count Ratemeter.*

3. *Instruction Manual Ludlum Model 43-1-1, Digital Scalar/Ratemeter.*

4. SOP-R-SUR-004, *Collection, Handling, and Analysis of General Smear Samples for Environmental Investigations*, Parsons Infrastructure and Technology Group, Inc., Richland, Washington current version.

5. QA-15.0, *Quality Assurance Procedure, Nonconformance Control*, *Quality Assurance Manual*, Parsons Infrastructure and Technology Group, Inc., Richland, Washington, current version or equivalent Project specific nonconformance procedure.

4. DEFINITIONS

1. **Geometry** as used in this procedure refers to the relative configuration between:
   - The radiation source and the detector (e.g., point source beneath detector centerline a 1 cm form the detector face) and the material,
   - The distribution of the radioactive material in the radiation source.
   - The type and amount of any materials between the source and the detector.
   - The materials associated with the radiation source and any associated container including back-scatter surfaces.

1. **Ludlum Model 2241 ratemeter with a 43-1-1 detector** is an instrument used to detect the presence of alpha radiation on surfaces and assess the flux measured, which can be used to extrapolate the activity on the surface.

2. **Ratemeter** is an electronic device that sums pulses received from a detector over a set time period (typically very short) and displays this count in the form of equivalent counts per minute (cpm).

3. **Scalar** is similar to a ratemeter but this instrument counts the pulse for a time period, typically set by the operator, and displays the total counts for this time period.

4. **Scintillator** a detector that produces light pulse that are then detected and changed to electrical pulses by photomultiplier tube.

6. **Survey Area** is an area where radioactive materials or contamination are or may be present. Survey areas include areas where samples/smears (which may contain radioactivity) are being screened.

5. GENERAL REQUIREMENTS AND LIMITATIONS

1. Use a Ludlum Model 2241 ratemeter with a 43-1-1 detector or an equivalent instrument system specifically authorized by the PHP.

2. The survey requirement will be established by the work plan, safety plan, and/or equivalent documents for the project or specifically provided by the PHP.

3. Only qualified and trained personnel are allowed to implement this procedure.

4. A background determination and instrument operational check in accordance with this procedure shall be performed prior to the first use of the instrument on each shift.

5. The instrument shall be fully functional prior to using in the survey area.

6. If the instrument appears to have failed during use in the survey area, then leave the survey area immediately.

7. **NEVER ADJUST THE CALIBRATION CONTROLS.**

8. Take care not to puncture the thin mylar window of the detector, especially when working outdoors in vegetated areas or surfaces with protrusions.

9. The count ratemeter, cable, and detector are calibrated as a unit and may not be interchanged without recalibration.

6. RESPONSIBILITIES

6.1 Project Health Physicist (PHP) is responsible for:

1. Ensuring that the selection and survey requirements are consistent with the technical requirements of this procedure, the regulations, applicable project documentation, and good health physics practices.
2. Training the Radiological Control Technician (RCT) in the proper use of this procedure.
3. Providing independent review of the documentation and data to ensure it is consistent and credible, and following up on data anomalies on a regular basis (i.e., typically weekly) or arranging for review of the data by a professional health physicist.
4. Ensuring that the instruments are properly maintained and calibrated at specified intervals.
5. Training the RCTs in the proper use of this instrument.
6. Identification and specification of equivalent instrumentation to be used with this procedure.
7. Reviewing the instrument field test and measurement data to ensure that the data is consistent and credible, and following up on data anomalies.

6.2 Radiological Control Technicians (RCT) are responsible for:

1. Implementing this procedure and the applicable training.
2. Reporting any unsafe or unusual conditions to the Field Supervisor and/or Safety Officer.
3. Reporting out of specification conditions to the Project Health Physicist and/or Field Supervisor.
4. Operating this instrument in accordance with this procedure and the applicable training.
5. Maintaining daily operational check records for each instrument.
6. Documenting data collected using the instrument in accordance with appropriate regulations and procedures.
7. Reporting instrument malfunctions to the Project Health Physicist.

6.3 Project Manager (PM) (or designee, such as the field supervisor)

1. Provides required materials and trained/qualified personnel for implementation of the task.
2. Provides operational review of the project specific activities for these data collection activities.

3. Determines the applicability of this procedure beyond the areas specifically identified in Section 2.

6.4 Field Supervisor (FS)

1. PM site representative and responsible for routine supervision of the task.

2. Verifies completion of the task.

7. PROCEDURES

Note: When surveying, the detection of increased activity can be more effectively identified by the audible sound than by monitoring the meter movement or digital display. Use the sound to locate the activity and the meter or display to assess the count rate or counts.

Note: This instrument typically has the following specifications:

- The detector is 75 cm^2.
- Efficiency 30% for Pu-239, 30% for Sr-90/Y-90, and 5% for C-14.
- The meter is digital.
- The discriminator is set so that only alpha activity is detected.
- The meter is powered by batteries an in-use life of at least one shift.

Note: If at anytime during this procedure there are conditions that may impact the results, note this information in the comment section or on the back of the applicable datasheet.

Note: Radioactive decay is a statistical phenomena and at low count rates the radiation emission rate will fluctuate significantly. In estimating count rates, the central tendency of the count rate (e.g., meter position) and not the upper or lower bound is relevant. It addition, in addressing survey activities, the background radiation from natural and unrelated man-enhanced radiation (e.g., fallout, some welding rods, exit signs, smoke detectors) typically changes significantly as a function of location due to changes in materials present. It is important to recognize that soils, rocks, concrete, blocks, and ceramics typically have significant levels of ambient background associated with them and care should be exercised to not miss-identify these materials as contaminated when only ambient background is present.

Note: This procedure is for using the Ludlum Model 2241 ratemeter with a Ludlum Model 43-1-1 detector. Equivalent substitutions may be used, per authorization of the PHP.

Note: If this activity involves a trainee then both the trainee and the RCT performing the on-the-job training print/initial/sign their names.

Note: It is acceptable to add attachments containing the information to the Daily Operational Check Log (Exhibit 1) and then reference this attachment (i.e., attachments are not included in the datasheet page count but are numbered separately) on the datasheet. In addition the Daily Operational Check Log maybe continued using a continuation sheet (see Exhibit 1). When a continuation sheet is initiated the relevant data must be transferred from the previous datasheet and the page count continued.

WARNING: Exposure of the detection surface to high intensity light (e.g., direct sunlight) can cause the significant increases in the instrument reading. Also pinhole leaks can also have this effect.

Note: The datasheets in the Exhibit in this procedure are controlled under procedure SOP-R-SUR-001.

1. PHP — Reviews the work plan, site data, regulatory requirements, customer requirements, and other applicable documentation with the PM and establishes the appropriate survey requirements, equivalent instrumentation, count times, and action levels for implementing this procedure.

2. FS/PHP — Directs initiation of the survey activity in accordance with this procedure.

3. PHP — Provide the RCT with the data identified in step 1.

4. RCT — **5. Ensure that meter and detector match the calibration certificate prior to operating.**

- **Assign an unique meter number to the instrument, which does not have one.**
- **Attach an identifying label to the side of the meter, which does not have one.**
- **Record the meter number, meter and detector serial numbers, and calibration information on the Survey Instrument Log.**

6. RCT — **7. Record the following information on the Daily Operational Check Log (Exhibit 1) prior to using the instrument. A separate log needs to be maintained for each instrument used.**

- Project Title and Number,
- Meter Make/Model and Serial Number,
- Detector Make/Model and Serial Number,
- Last Date Calibrated,
- Calibration Due Date,
- Applicable units for background and source counts (typically cpm, counts),
- Applicable count time if scalar counts are made or an R for ratemeter readings, and

8. RCT — **9. If the meter or detector is due for calibration, it must be tagged "Calibration Due" and given to the Project Health Physicist (or Field Supervisor if Project HP is unavailable). Instruments requiring calibration shall not be used for taking radiation measurements in survey areas.**

10. RCT Check the high voltage setting and ensure that it is set as recommended on the appropriate meter calibration certificate. If the voltage is not properly set, contact the Project Health Physicist for further direction.

11. RCT Document these activities on the operational Daily Operational Check Log.

12. RCT Records the Background and Source Check count time for "Scalar" mode on the datasheet. If the instrument has no scalar mode record an "R" on the count time line.

13. PHP Review the datasheet routinely and once it is completed per Section 7.12, and once any data anomalies have been resolved, sign and date the datasheet, then store this record in accordance with applicable Parsons and project procedures and client requirements.

14. General The data on the datasheet should not be released to the client until Step 13 has been completed.

15.

7.2 Operational Checks

Note: This section of the procedure maybe implemented in conjunction with the sampling/survey activity. It is acceptable to add attachments containing the information to the Sampling/Survey Grid Datasheet and then reference this attachment on the datasheet. Any attachments are separately numbered and not part of the Datasheet page numbering.

1. RCT **Visual Inspection of Instrument--** Each instrument shall be inspected at the start of each work shift to identify potential problems or damage prior to being used in the survey area.

2. RCT **Visual Inspection of Instrument--** The date and time of this check and the name of the person performing the check shall be recorded on the Daily Operational Check Log (Exhibit 1) that corresponds to the meter/detector serial numbers in conjunction with documentation of the other activities in this section.

3. RCT **Visual Inspection of Instrument--** Visually check the instrument for signs of physical damage (e.g., broken or loose cables; missing screws or other parts; and inoperable switches or knobs) and ensure that the calibration due date has not passed.

4. RCT **Visual Inspection of Instrument--** Report any damage or other problems (not already documented on the log) to the Project Health Physicist to determine if the equipment can still be used. Malfunctioning instruments are not to be used in the survey area, without specific authorization of the Project Health Physicist.

5. PHP **Visual Inspection of Instrument**—Assesses the significance of the damage and based on good health physics practices determines if the instrument should not be used. Also provides information based on this determination to the RCT to be recorded in the "Remarks" section.

6. RCT **Visual Inspection of Instrument**—If the instrument is damaged and should not be used (i.e., based on discussion with the {PHP) indicate "N" in the Visual/Battery Check portion of the log and terminate this procedure. Document the damage in the "Remarks" section.

7. RCT **Battery Check--** The batteries in each meter shall be checked at the start of each work shift to ensure proper operation prior to being used in the survey area. Turn the meter on and allow several minutes for the instrument to "warm-up" and stabilize.

8. RCT **Battery Check--** Test the batteries to ensure that the unit is functional by turning the dial to the "BAT" position. The battery strength is indicated by the needle deflection.

9. RCT **Battery Check--** If the meter reading indicates that the batteries are good (e.g., needle deflection into the "BAT TEST" portion of the scale), enter "OK" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column.

10. RCT **Battery Check--** If the batteries are weak, turn off the meter and replace the weak batteries with new batteries. Recheck the meter in accordance with Steps 7 through 10 to ensure that the new batteries are good. If the meter indicates that the batteries are good, enter "Replaced" on the Daily Operational Check Log (Exhibit 1) under the "Visual/Battery Check" column to indicate that the batteries were replaced.

11. RCT **Battery Check--** If the meter indicates that the new batteries are not good, replace the batteries again and retest the meter. If the meter is still not functioning properly after trying two new sets of batteries, take the meter out of service and contact the Project Health Physicist. Enter "F" (Failed) on the Daily Operational Check Log (Exhibit 1) under the "Battery Check" column to indicate that the meter was taken out of service.

12. RCT Continue Procedure in Section 7.4, Background Check.

7.3

7.4 Background Check

1. RCT After completing the visual inspection and battery check (see Section 7.2), a background check shall be performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift background check should be completed.

2. RCT Background readings shall be measured in a low background area to verify proper instrument operation by measuring a consistent background radiation level, and to ensure that the detector is not contaminated. When practicable, the background area selected shall be similar to the conditions encountered in each survey area. Obtain the source count jig.

3. RCT All background checks shall be conducted at the same location and in the source count jig to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials outside of the survey area, such as smears and air samples (as discussed in Section 7.10).

4. RCT Ensure that the meter is on and properly "warmed-up" and set the speaker button "ON", if applicable.

5. RCT The detector face is to be orientated in the source count jig with the face down, consistent with Section 7.6. Ensure that all radiation sources are removed (at least 10 feet away) from the area during the background check.

6. RCT If a ratemeter background is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.

7. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column and go to step 10.

8. RCT If the scalar mode data is to be collected (i.e., a count time is specified), set the meter to scalar count time and the counting time to the value on the Daily Operational Check Log and initiate the scalar count.

9. RCT Record the reading in cpm or count on the Daily Operational Check Log (Exhibit 1) under the "Background Check" column.

10. RCT Enter the background data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The background data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

11. RCT If this background data exceeds the allowed variation from the mean (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicates the instrument is beyond the acceptable tolerance for variability.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

12. RCT If the background reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 background values are being accumulated in the control chart data set, a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of background through time, thus collection of several data point in a short time span does not provide useful data since the background is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

13. RCT If the background exceeds 2 standard deviations repeat steps 6 to 13 once, contact the PHP for instructions if the excess deviation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations criteria from step 12, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Background Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column. Also indicate the type of action (i.e., decontamination) that was taken for the recheck measurement.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

Note: A possible reason for a high failure would be contamination of the detector. Once the detector has been decontaminated this procedure maybe re-initiated, but this should be included in the remarks column.

14. RCT If a source check is required proceed to Section 7.6.

15. RCT If a source check is not required complete return to the applicable section of this procedure.

7.5

7.6 Source Check

1. RCT After completing the background check (see Section 7.4), a source check is typically performed at the start and end of each work shift prior to using the instrument in the survey area. If practicable, when significant amounts of data is being collected a mid-shift source check should be completed. Obtain the source jig if it is not present from Section 7.4 activities.
2. RCT Source readings shall be measured in a low background area in the source jig to verify proper instrument operation by measuring a consistent source plus background radiation level, and to ensure that the detector is not contaminated.
3. RCT When practicable source checks shall be conducted at the same location to provide a consistent or at least documented background radiation level. Often this is the background level for the counting of materials, such as smears and air samples, outside of the survey area (as discussed in Section 7.10).
4. RCT
   - Ensure that the meter is on and properly "warmed-up" and set the speaker button "ON".
5. RCT Obtain the check source(s) for this instrument. Use the source #(s) on the Daily Operational Check Log, if the data is unavailable use the source(s) designated by the PHP.
6. RCT Carefully place the source in the jig facing up.

   CAUTION: ***Do not contact the active surface of the sources*** **with your skin. This can result in unnecessary radiation exposure. These contact doses are typically significantly higher than generally expected by personnel. In addition, the chemical on the skin surface may damage the source invalidating its calibration and possibly causing the release of radioactive contamination.**
7. RCT Orient the detector face so it is facing the source at the fixed distance and in the fixed orientation established by the jig. Ensure that all other radiation sources are removed (at least 10 feet away) from the area during the source check.
8. RCT If a ratemeter source check is to be collected (i.e., an "R" is indicated for count time), allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle fluctuation can be read.
9. RCT Record the reading in cpm on the Daily Operational Check Log (Exhibit 1) under the "Source Check" column and the "Source #" in its column, then go to step 12.
10. RCT If the scalar mode data is to be collected (i.e., a count time is specified), set the meter to scalar count time and the counting time to the value on the Daily Operational Check Log and initiate the scalar count.
11. RCT Record the reading in counts or cpm on the Daily Operational Check Log

(Exhibit 1) under the "Source Check" column and the "Source #" in its column.

12. RCT Enter the source check data into the control chart for this instrument (see Exhibit 2 for an example of a control chart) and calculate the control chart data indicated if not automated. The software used to produce the control will calculate the mean value and the two standard deviation value for this mean. If software is not used these values must be calculated by hand.

Note: The source check data entered in the control chart must be at least 1 hour apart and never enter more than 3 values for any one shift.

13. RCT If the source check data exceeds the allowed variation from the mean calculated in the control chart activities (see the Daily Operation Check Log for limits) then indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation. Exceeding the limit in the log indicate the instrument is beyond the acceptable tolerance for variability.

14. RCT If the source check reading is within 2 standard deviations of the average for the control readings specific to the instrument, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column if at least 5 data points widely separated in time have been collected.

While the first 5 source check values are being accumulated in the control chart data set. a guide of the mean +/-20%, rather than the 2 standard deviation value should be applied to this data in assessing if it falls within 2 standard deviation of the mean.

Note: Until five values are collected the mean and standard deviation of this mean may not have converged to a statistically valid value. The intent of this data is to characterize the variability of the instrument performance through time, thus collection of several data point in a short time span does not provide useful data since the instrument performance is a slowly varying value. The inclusion of several data points in this data set collected over a short period of time will actual skew the results.

15. RCT If the source check value exceeds 2 standard deviations repeat steps 7 to 15 once, contact the PHP for instructions if this excess variation reoccurs. Notify the PHP even if the instrument passes on the second try within 3 days.

If the meter reading is now within 2 standard deviations of the average for the control readings, enter "P" (Pass) on the Daily Operational Check Log (Exhibit 1) under the "Source Check - Pass/Fail" column and entry "Recheck" in the "Remarks" column.

If it is determined that the instrument is malfunctioning or contaminated, indicate "F" (Fail) for the instrument, tag out the instrument, and terminate this operation.

16. RCT Describe any off-normal conditions that occurred during this process (this includes Sections 7.4 to 7.6 activities) in the "Remarks Column" and then initial entry.

17. RCT Return the source to the appropriate storage area.

18. RCT Record the data , time, and initial the entry, then submit the datasheet to the FS.

19. FS Verify activity completion and initials after the RCT.

20. RCT Proceed to the applicable section for completion of data collection activities. At the termination of an activity or withdrawal of an instrument from usage arrange for transmission of the Daily Operational Check Log to the PHP for action and maintain a copy of this log in a manner consistent with the applicable Parsons/project records management procedure.

21. PHP Review the datasheet per Section 7.12, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

22. General The data on the datasheet should not be release to the client until Step 21 has been completed.

7.7 Survey of Surfaces or Items

Note: This instrument will be used to determine if radiological contamination (alpha-emitting radioisotopes) are present on the **surfaces** of floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

CAUTION: This instrument is not effective for the detection of tritium (i.e., H-3) beta emissions.

1. RCT Verify that Sections 7.4 to 7.6 have been completed for the shift and instrument (i.e.. detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "N" to indicate that is a static count,
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and
- The count time indicated as "R".

3. RCT **4. Ensure that the instrument is on and properly "warmed-up".**

5. RCT Set the instrument on the appropriate scale, if required.

6. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check source to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operation per Sections 7.4 to 7.6.

7. RCT Ensure the speaker is on.

8. RCT Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.

9. RCT Scan at a rate of 1 inch every 2 seconds to give the instrument time to respond. Scan rates greater than two inches per second drastically reduce the probability of detection. The operator should listen to the audio output closely since it responds faster than the meter reading.

10. RCT For a ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the digital fluctuation can be read.

11. RCT If the reading exceeds 10,000 dpm/100 cm^2 (1,670 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required

12. RCT When surveying, any response above background should be investigated by holding the detector still to verify that the radiation rate is above background.

13. RCT If a reading above twice background or the action level provided by the PHP for this survey is confirmed, a static measurement should be taken in accordance with Section 7.9 of this procedure.

14. RCT Continue scanning the entire surface within the designated area.

15. RCT If localized contamination is found the RCT may, decontaminate the surface per applicable Parsons procedure or other instructions provided by the Project Health Physicist.

16. RCT Resurvey the decontaminated areas per Steps 8 through 16.

17. RCT **18. Record the scanning (i.e., highest reading in the area after any localized decontamination) and decontamination information on the Surface Radiation Field Measurement Data Sheet (see Exhibit 3).**

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

19. RCT Repeat Steps 9 through 19 for each surface measurement location.

20. RCT **21. Per direction of the PHP/FS or at the RCT discretion complete Sections 7.4 and/or 7.6 to re-verify instrument performance. This is often completed whenever there is a break in work activities.**

22. RCT Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.

23. FS Review and if completed properly, sign and date the datasheet, then store this in-process record in accordance with applicable Parsons and project procedures and client requirements.

24. PHP Review the datasheet per Section 7.12, and once any data anomalies have been resolved, sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.

25. General The data on the datasheet should not be release to the client until Step 24 has been completed.

7.8

7.9 Field Static Counts

Note: This instrument will be used to determine if radiological contamination (alpha-emitting radioisotopes) are present on the **surfaces** of floors, walls, soils, or equipment. These direct surface measurements shall be taken prior to collecting smear samples to be representative of total (e.g., fixed plus removable) contamination levels. **Where the survey distance is variable due to surface variation note this in the remarks section.**

Note: The Surface Radiation Field Measurement Datasheet (Exhibit 3) is used to document these results. The data can be place in either the left or the right columns for "Direct Surface Readings" and the other columns set used for another measurement, which maybe taken in conjunction with this activity. When the data collection extends beyond the initial page a continuation sheet may be used. If the continuation page is used transfer the information from the previous datasheet to the continuation page header and continue page numbering. Attachments to these datasheets should be reference and separately number and not included in the datasheet page count.

Note: This survey maybe conducted simultaneously with other surveys, implemented in accordance with other sections of this procedure or other applicable procedures.

1. RCT Verify that Sections 7.4 to 7.6 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Complete the initial portion of the Field Measurement Datasheet. Including the following data:

- Project and Building/area information,
- Datasheet number and page,
- Print the name of the surveyor and FS,
- Instrument "Type" and the units of the "Value" it provides,
- A "Y" or "N" to indicate if this is a static count,
- If an alternative survey distance (i.e., typically 0.5 ± 0.5 cm) is required record this value in cm, and

The count time in minutes, indicate "R" in this space if the survey is being made in ratemeter mode.

3. RCT Ensure that the instrument is on and properly "warmed-up".

4. RCT Set the instrument on the appropriate scale, if required.

5. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.4 to 7.6.

6.	RCT	Ensure the speaker is on.
7.	RCT	**8. Per direction of the PHP/FS or at the RCT discretion complete Sections 7.4 and/or 7.6 to re-verify instrument performance. This is often completed whenever there is a break in work activities.**
9.	RCT	Hold the detector face at the specified distance from the surface being measured, or at the alternative distance is specified on the Surface Radiation Field Survey Datasheet if a value is specified.
10.	RCT	If this is a scalar mode measurement initiate a scalar count or if a ratemeter measurement allow the meter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.
11.	RCT	If the reading exceeds 10,000 dpm/100 cm^2 (1,670 Bq/100 cm^2) or alternate action level specified in the RWP or health and safety plan, respiratory protection is required.
12.	RCT	Record the surface reading in cpm on the Surface Radiation Field Measurement Data Sheet (Exhibit 3). The location of the measurement is also to be recorded on the Data Sheet.

NOTE: Avoid filling out unnecessary paperwork in contaminated areas or radiation fields.

13.	RCT	**14. Repeat Steps 9 through 13 for each location.**
15.	RCT	Record the total page count on each page and sign and date the datasheet, then submit the datasheet to the FS.
16.	FS	Review and if completed properly, sign and date the datasheet, then stores this in-process record in accordance with applicable Parsons and project procedures and client requirements.
17.	PHP	Review the datasheet per Section 7.12, and once any data anomalies have been resolve sign and date the datasheet, then stores this record in accordance with applicable Parsons and project procedures and client requirements.
18.	General	The data on the datasheet should not be release to the client until Step 17 has been completed.

7.10 Counting of Smear, Air Samples, and Other Materials

CAUTION: Smears, samples, and equipment should be handled as potentially contaminated material during this process.

Note: If shield sources, sources, or smears are used in this process these maybe completed integral to the unshielded counting process to minimize the handling of the radioactive or potentially radioactive materials.

1.	PHP	Specify the appropriate counting system geometry and sources for used in calibrating/source checking this configuration and provide this information to the RCT.
2.	RCT	Obtains the counting jig/configuration system and sources specified by the PHP.
3.	RCT	Verify that Sections 7.4 through 7.6 have been completed for the instrument.
4.	RCT	Complete a background count for the counting jig/configuration per Section 7.4, being sure to use the control charts and actions level for this specific geometry for the instrument and not the general geometry for the instrument.
5.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the Surface Radiation Field Measurement Datasheet" used to record this data, which is a possible reference.)
6.	RCT	Complete a source count for each source designated by the PHP for the counting jig/configuration per Section 7.6, being sure to use the control chart and action level for this specific geometry for the instrument and not the general geometry for the instrument.
7.	RCT	Reference the geometry in the "Remarks" section of the form. (The geometry must be described in detail in the "Specific Geometry" section of the "Surface Radiation Field Measurement Datasheet" used to record this data, which is a possible reference.)
8.	RCT	If the PHP indicates that partially shield sources will also be used in this evaluation, repeat steps 6 and 7 with these shielded sources indicating the source and the shield(s) provided in the "Source #" column.
9.	RCT	Return the source to the appropriate storage area.
10.	RCT	Place the sample in a jig or other container to establish the fixed geometry specified by the PHP
11.	RCT	Perform the static count of the samples in accordance with Section 7.9 in a low background area. The sample number and any associated shield used in the count are the location. The samples are to be counted in the jig.
12.	RCT	If the PHP indicates that a sample(s) should be counted in a shield geometry as well as without the shield, the process described in steps 10 through 12 should be completed with the shield samples as well and the shield number added to the sample location description as well.
13.	RCT	Document the geometry for these counts including any shielding used in the "Specific Geometry" section of the Surface Radiation Field Measurement Datasheet.
14.	RCT	Samples should be handled as potentially contaminated material after counting.

7.11 Personnel Surveys

Note: This instrument will be used to determine if radiological contamination (alpha-emitting radioisotopes) are present.

1. RCT Verify that Sections 7.4 to 7.6 have been completed for the shift and instrument (i.e., detector, meter, and cable) to be used in this activity.

2. RCT Ensure that the instrument is on and properly "warmed-up".

3. RCT Set the instrument to the lowest scale consistent with the ambient background, if required.

4. RCT If the instrument has an attached check source record the check source reading, otherwise indicate NA in this column.

Note: For instruments with an attached check source, throughout the survey process occasionally check the instrument reading on the check source to verify operation. If this value deviates by more that 20% note this in the remarks and recheck the instrument operations per Sections 7.4 to 7.6.

5. RCT Ensure the speaker is on.

6. RCT Hold the detector face within 0.25 inches of the surface being measured.

7. RCT Scan at a rate of 1 inch every 2 seconds to give the instrument time to respond. Scan rates greater than two inches per second drastically reduce the probability of detection. The operator should listen to the audio output closely since it responds faster than the meter reading.

8. RCT If an apparent reading above background is detected allow the ratemeter reading to stabilize (approximately 20 seconds) until the central tendency of the needle or digital fluctuation can be read.

Note: Survey activities should be particularly thorough for areas that routinely come in contact with potentially contaminated surfaces (e.g., hand and feet).

9. RCT If radioactivity is present in excess of the action levels in the safety plan or equivalent documentation, identify the area and document the activity on a personnel contamination datasheet, when time is available.

10. RCT **CAUTION: Overly aggressive decontamination may result in breaching the skin surface, resulting in the introduction of the radioactive material into the body (i.e., the injection pathway) and results in substantial increase in personnel dose. Any action with the potential to seriously injury the individual or lead to introduction of radioactive into the body should only be undertaken under the direction of a physician. Decontamination of wounds, aside from flushing with soap & water or wound disinfectants should be completed only under the direction of a physician.**

Decontaminate surface or remove and dispose of contaminated protective or other clothing. Decontamination shall be handled in a manner consistent with the applicable health and safety plan.

11. RCT/FS/HP **CAUTION: Documentation of the contamination data should not be allowed to interfere with the timely decontamination of the individual.**

CAUTION: This Personnel Contamination Datasheet is Privacy Act data and shall be handled as such. This data is NOT a project record and the management of this record is addressed by the Parsons Health and Safety Program.

If contamination was detected document the following data on the pre and post decontamination conditions on the Personnel Contamination Datasheet:

- Person's full name.
- Person's employer.
- Person's employee number, addresses, and assigned permanent work location,
- A detailed drawing of the location of the contamination.
- The activity distribution in the contaminated area(s),
- The projected radionuclides that are potentially present in the area.
- The lapse time from when the individual might have become contaminated (i.e., typically when the individual entered the contaminated area) until the contamination was removed or reduced.
- The time any identified residual activity remained on the individual.
- The instrument (include both meter and detector) manufacturer, model, and serial number used in the survey.
- Copy of the calibration certificate for the detector,
- Description of any decontamination activity and associated actions,
- Name of the name, employer, employee number, address, and assigned permanent work location of the:
  - Health and Safety Officer,
  - Field Supervisor, and
  - Health Physicists involved,.
- Surveyor, site Health Physicist (if any), and Field Supervisor print their names and then sign and date the form.

12. FS Submit the Personnel Contamination Datasheet to a professional health physicist (preferably a Certified Health Physicist) who will review the data and assess the dose.

13. HP Assess the localized radiation dose associated with this exposure consistent with:

- 10 CFR 20 and/or 10 CFR 835, as applicable,
- ICRP and NCRP guidance, and
- good health physics practices.

14. HP Document the assessment on the Personnel Contamination Datasheet, including the verification and validation of any software used. If this assessment of dose involves a dose calculation the calculation must meet the applicable Parson's calculation procedure.

15. HP Print name and title, sign, and date the data sheet.

16. HP Transmit a copy of the completed form to the responsible health and safety officer and archive the original consistent with Parsons Health and Safety Program.

17. Health & Safety Officer **18. Provide a copy of the Personnel Contamination Datasheet to the individual and brief the individual on the associated risks and provide the contact information for the HP who completed the dose assessment.**

19. HP Provide follow-up assistance and information to the employee and the Health and Safety Officer.

7.12 Data Verification

This is the initial step in the verification and validation of the data generated by this procedure, the final steps will be addressed by the verification and validation process describe in the applicable workplan or similar document.

1. HP On the routine basis established in the work plan or if no basis is specified at least every 10 working days, obtain the datasheets (i.e., Exhibit 1) generated by this procedure. The datasheets can normally be identified by reviewing the activity logbook(s).

2. HP Review the datasheets to ensure all information is complete. If not, resolve the incomplete data in a manner consistent with applicable quality assurance procedures.

3. HP Review the data for the following technical considerations:

- Are the data technically consistent,
- Are the calibrations of the instrument current, valid for the intended use, and of sufficient accuracy for the intended use,
- Were appropriate and current calibration and check sources used,
- Is there appropriate documentation for all calibrations (e.g., meters, detectors, and sources) in the records,
- Are the background values credible and are the background data consistent with the statistical variability expected,
- Are the expected progeny present and in the appropriate ratios based on relative activities,
- Is the expected level of background radiation present,
- Have appropriate backgrounds data set been obtained,
- Is there consistency between these values and the other survey data,
- Are the radiation types and radionuclides present in credible relative ratios,
- Is additional count time required to meet data quality objectives,
- Does the equipment appear to be functioning properly,
- Were any technical concerns/inconsistencies appropriately followed up on and resolved, and
- Are there any other outstanding technical, operational, or quality issues associated with the data.

4. HP If there are problems or potential problems associated the data, the HP initiates the any designated SOPs, as appropriate, and/or the Nonconformance Report Process to resolve the concerns and ensure data integrity.

5. HP If the data does not have any outstanding problems, the HP signs the datasheet as verified and stores the documentation in accordance with applicable procedures and Project Management direction and terminates this procedure.

6. HP Document the nonconformance report (NCR) number(s) (i.e., notes in the "Data Verified" line indicating that the data is verified with closure of NCR #(s) ___) associated with this verification.

7. HP Once the datasheet is completed and any applicable NCRs are generated, sign and date the Datasheets as verified (i.e., verified pending resolution of outstanding NCRs) and store the documentation in accordance with applicable procedures and Project Management direction, then terminate this procedure.

8. RECORDS

Exhibits 1 and 3 and any associated attachments and any applicable associated NCRs are the quality records generated by this procedure. Exhibit 4 is not project related and not managed under the project QA system. It is a Parson's record and will be managed in a manner consistent the applicable office and Parson Health and Safety Program.

.1 Exhibit 1

PARSONS

Daily Operational Check Log
Instrument #__________

SOP-R.SUR-1-1 -__________ Page __ of ___
Revision 0
Last Date Calibrated: __________

Calibration Due Date: __________

Project Title: __________
Project Number: __________
Prepared By Print: __________
Prepared By Signature: __________ Date: ______
Verified By Signature: __________ Date: ______

Meter Make/Model: __________
Meter Serial No.: __________
Detector Make/Model: __________
Detector Serial No.: __________

(optional data enter as needed)
Isotope: _____ Efficiency: _____
Isotope: _____ Efficiency: _____
Isotope: _____ Efficiency: _____
Isotope: _____ Efficiency: _____
Channel 1 Window: _____ to _____ (keV)
Channel 2 Window: _____ to _____ (keV)

Voltage Consistent With Calibration Certificate			No	Acceptable Background Range		Acceptable Source Check Range	

Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___-minute Scalar)	Pass/ Fail	Gross Reading (cpm) (___-minute Scalar)	Source #	Pass/ Fail		

.2 **Exhibit 1 (Continued)**

PARSONS Daily Operational Check Log (Continuation Sheet) SOP-R.SUR-1-1 -__________ Page ___ of ___

Instrument #__________ Revision 0

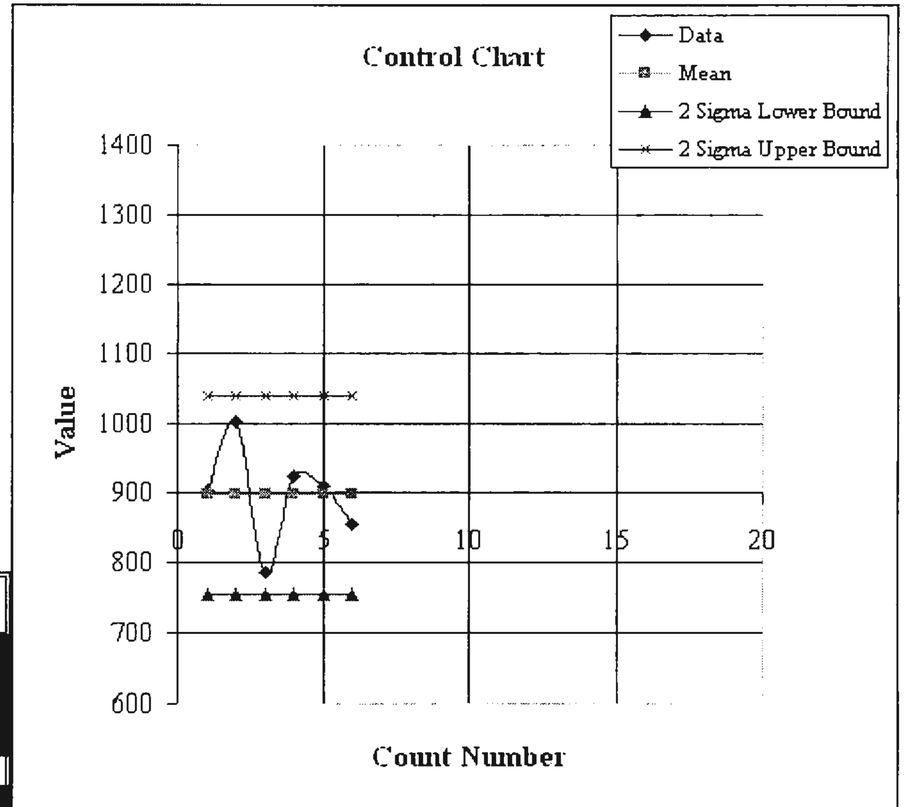
Date/ Time	Performed By (Print and initial)	Visual/ Battery Check	Background Check		Source Check			Channel (optional)	Remarks
			Gross Reading (___) (___-minute Scalar)	Pass/ Fail	Gross Reading (___) (___-minute Scalar)	Source #	Pass/ Fail		

.3 Exhibit 2

Example of a Control Chart

Parameter Being Tracked	Cs-137 0.661 MeV peak counts, post fine tuning
	Electectronics
Instrument Type	URSA-MCA
Model Number	Universal Radiation Spectrum Analyzer
Manufacturer	RSA
Serial Number	20291
	Detector
Instrument Type	Fidler
Model Number	M-23
Manufacturer	Ortec
Serial Number	X-111
Geometry	Center Line Area Source at 4"
ROI	Cs-137 0.661 MeV peak
	Count Data
	Mean= 897.1667
	STDEV= 71.46025

Date/Time	Data Number	Data	Pull Block	Status
1/1/00 0:00	1	905	[redacted]	[redacted]
1/5/00 0:00	3	1001	[redacted]	[redacted]
1/6/00 0:00	4	787	[redacted]	[redacted]
1/7/00 0:00	5	923	[redacted]	[redacted]
1/10/00 0:00	6	911	[redacted]	OK
1/2/00 0:00	2	856	[redacted]	[redacted]



.4 **Exhibit 3**

PARSONS

Surface Radiation
Field Measurement Datasheet

SOP-R-SUR-1-2- ________ Revision 0
Page ___ of ___ Date: ________

Project Title: ________________

Project Number: ________________

Building/area/Floor: ________________

Room/Unit Designation: ________________

Surveyor (print): ________ Surveyor Signature: ________ Date: _____

Verifier (print): ________ Verifier Signature: ________ Date: _____

Complete FS (print): ________ FS Signature: ________ Date: _____

Measurement Location		Direct Surface Reading static Y/N Type _______ Count Time (M) ______			Direct Surface Reading static (Y/N) Type _______ Count Time (M) ______			Alt. Distance (optional) ________ cm (left instr) Alt. Distance (optional) ________ cm (right instr)
No	Per Reference Map	Value (________)	Channel (optional)	Instr. #	Value (______)	Channel (optional)	Instr. #	Remarks
Instr. Check Source								

Specialized Geometry (optional):

Exhibit 3 (continued)

PARSONS

Surface Radiation
Field Measurement Datasheet (continued)

SOP-R-SUR-1-2- ________ Revision 0
Page ___ of ___ Date: ________

Measurement Location		Direct Surface Reading			Direct Surface Reading			Remarks
No.	Per Reference Map	Value (______)	Channel (optional)	Instr. #	Value (____)	Channel (optional)	Instr. #	

.5 Exhibit 4

PARSONS				Personnel Contamination Datasheet			SOP-R-SUR-1-3 Page 1 of 2		Revision 0 Date:
Individual' Name:					Employer			Employee #	
Individual's Address:					Permanent Work Location:				
No	Location (ref. Drawing attached)	Instrument	Activity	Activity Units	Instrument	Activity	Activity Units	Remarks/Comments	

Instrumentment Data					Projected			
No	Manufacturer	Model	Seria	Attach	Lapsed Time for initial exposure		Basis:	
					Lapsed Time for residual exposure		Basis:	
					Decon Actions:			

Position	Name (Print)	Employer	No.	Permanent Work Location & phone #)	Signature	Date
Health and Safety						
Field Supervisor						
Health Physicist (if						
Surveyor						

.6 **Exhibit 4 (continued)**

PARSONS	Personnel Contamination Datasheet	SOP-R-SUR-1-3 Page 2 of 2	Revision 0 Date: ____

Analysis Health Physicist		Employer		Phone	
Analyst's Title		Permanent Work Location:			

Regulatory Basis for Analysis		Analysis/Calculation of Dose Required	Yes		No	

Dose Analysis (Reference applicable Parson's Calculation Procedure) (if required):

Projected Dose				Explanation & Comments:
Organ/Location	Dose (mrem)	Dose (TEDE)	Total Effective	

Position	Name (Print)	Employer	No.	Permanent Work (& phone	Signature	Date
Original Project Manager					NA	NA
Analyst						
Reviewer		NA	NA	NA		

APPENDIX E

Response to Comments

Response to Comments on the
Draft Workplan for SEAD-48 (E0800 Row Pitchblende Ore Storage Igloos)

Response to the Comments from United States Environmental Protection Agency

Subject: Draft Workplan for SEAD-48
Seneca Army Depot
Romulus, New York

Comments Dated: April 12, 2002

Date of Comment Response: July 19, 2002

General Comments:

I. Introduction

The purpose of this workplan is to conduct a final status survey for the Pitchblende Storage Igloos (SEAD-48) following the MARSSIM guidance for closing out sites. In addition, this workplan discusses guidance on performing final status surveys and the selection of analytical methods.

During the 1940's, eleven ammunition igloos at Seneca Army Depot were used for the temporary storage of approximately 2,000 barrels of pitchblende ore. Pitchblende, also known as uranite, is the source ore for uranium and, consequently, contains relatively high concentrations of naturally occurring radioactivity from uranium and its daughter products.

The workplan is essentially a document that compiles all of the historical information related to radioactive contamination (from the pitchblende) in the eleven storage igloos and establishes a rationale for classifying and addressing each igloo on a case by case basis. The classification process used is based on guidance found in the Multi-Agency Survey and Site Investigation Manual (MARSSIM). Further, the ultimate intent of the workplan is to use MARSSIM guidance to establish each igloo and surrounding land area as passing a final status survey, based on the identified release criterion (10 mrem/year, New York State Technical Administrative Guidance Memorandum for radionuclides in soil). Soil and building surface contamination levels were derived based on this dose requirement.

> The workplan is successful in establishing a reasonable rationale for classifying the igloos and surrounding land areas into MARSSIM Class I, Class II, and Class III survey units. There are some aspects of the workplan, however, that I feel require additional explanation (see specific comments, below).
>
> The Army has proposed using a sodium iodide (NaI(TI)) detector connected to a Universal Radiation Spectrum Analyzer (URSA). This analytical method was used to perform the remedial investigation of SEAD-12, also located at the Seneca Army Depot. The State of

New York Department of Health has suggested that a high purity germanium (HPGe) detector connected to the Canberra ISOCS system may be a better choice for performing final status survey measurements.

Response: The above concerns are addressed in the responses to the comments below.

II. Overall Survey Approach

Comment 1: While the workplan is very detailed in technical areas like instrumentation, it does not discuss data quality objectives (DQOs), which are thoroughly addressed in MARSSIM. A QAPP, should have been prepared or should be prepared, but there is no indication that one has been prepared (one is not listed in the workplan references). In any event, the workplan, should at least list the DQOs (assuming they are discussed in more detail elsewhere) and the workplan should address how the fieldwork and subsequent data analysis will satisfy the DQOs.

Response 1: A Quality Assurance Project Plan has been developed and has been added as Appendix D to the SEAD-48 work plan. This document addresses DQOs and the data analysis process.

Comment 2: A detailed project schedule should have been or should be provided. A workplan should describe when the work is expected to be completed, what are the key milestones, and what are the critical path items.

Response 2: A schedule has been added to Section 7 of the work plan that outlines the target dates and the key milestones.

III. Instrument Selection

Comment 1: There are several concerns regarding the proposed instrument selection for in situ gamma spectrometry, the Universal Radiation Spectrum Analyzer (URSA). The first concern is in regard to the detector. NaI(TI) detectors are rugged, reliable, low maintenance, and relatively inexpensive detectors that have been used to measure radiation for almost 70 years. Parsons provided several good references on the use of NaI(TI) detectors. The major concern when using NaI(TI) detectors is the interpretation of the gamma-ray spectrum. The low resolution of these detectors, combined with a tendency to drift as environmental conditions (e.g., temperature) change, can make interpretation of results difficult.

By contrast, the NYSDOH recommends a high purity germanium (HPGe). HPGe detectors excel in areas where NaI(TI) detectors are deficient. The resolution of HPGe detectors is much better than NaI(TI) detectors, improving the interpretation of HPGe spectra. Many of the improvements to NaI(TI) interpretation software have also helped to improve the interpretation of HPGe spectra. HPGe detectors are maintained at a constant temperature, so environmental fluctuations have little or no effect on the analytical results. However, HPGe detectors are much more expensive than NaI(TI) detectors. They are not as rugged and require more care when used in the field. HPGe detectors require liquid nitrogen or an electronic cooling system to keep them operating. HPGe detectors are generally not as mobile as NaI(TI) detectors.

While it appears that NaI(TI) systems were selected over HPGe systems for other projects, a NaI(TI) system should demonstrate significant benefits over HPGe. The proposal to use the NaI(TI) detector does not appear to be adequately supported.

Additional justification is needed.

Response 1: The NaI detector does have a lower resolution then the HPGe system, however, by using a FIDLER probe we increase the effective resolution of the system beyond that of the thick crystal NaI by lowering the background of the system. The resolution level of the FIDLER is sufficient for the purpose of identifying and quantifying the radionuclides present at SEAD-48.

To correct for possible drift that may occur with a NaI detector in response to environmental conditions, the instrument is functioned checked before and after each measurement. This allows for assurance that the instrument is responding at the correct energy levels before the reading, and that it was consistent through out the measurement. If significant drift were to occur during the course of collecting a measurement, the drift would be corrected and the reading would be recollected. A constant temperature will be maintained throughout the measurement by allowing the detector to acclimate to the ambient temperature, and by providing shielding for the detector from direct sunlight. Performing function checks provides confirmation that the instrument is functioning properly.

Comment 2: The second concern with regard to the URSA is that the workplan does not adequately acknowledge the effort that will be required to validate the analytical protocol. Using the NaI(TI) detector with the URSA hardware and software on this project will require validation of the analytical protocol. The validation level required would be at least level B, and more likely level C or F (Table 1, enclosed). Since no external PE samples are available for this type of measurement, some sort of reference material calibration of locations with elevated activity will need to be performed. The borehole measurements described in the Draft workplan should be adequate, but, if the draft MARLAP guidance for validation of analytical protocols were followed, the number of measurements would need to be adjusted according to the recommendations in Table 1. It is also unlikely that a site ready for a final status survey will provide the three levels of activity recommended by MARLAP, so some measurements would need to be performed in higher activity areas. These areas may be located on another site, which would make comparability of the sample matrix an issue.

The major objectives of the validation process include demonstrating that the assumptions concerning horizontal and vertical distribution of radionuclides are accurate, as well as demonstrating that interpretation of the NaI(TI) spectra accurately resolves the complicated combinations of peaks expected from the uranium, thorium, and actinium series radionuclides compared to the relatively simple problem of resolving the americium-241 peak from natural background. The fact that there are multiple radionuclides of concern, combined with the fact that all of the radionuclides are present in background and there are interferences that complicate assigning peaks to specific radionuclides, make this a more difficult problem than any previous application of this analytical protocol.

Additional discussion is needed.

Response 2: The validation of the URSA hardware has been completed through comparisons with known NIST traceable standards. The URSA vendor, Radiation Safety Associates Inc.(RSA), has also completed a comparison of the URSA using a 2x2 NaI detector and FIDLER detector with an EG&G 70% efficient HPGe system. This comparison utilized a multi-energy soil matrix source that would provide a complex spectrum similar to what is expected in the field. Additionally, RSA has also used multi-energy area sources to assist in validating the URSA. Parsons has also completed the initial calibration and will perform the system function checks with a multi-energy area source. It should be noted that this NaI system as it has been in use and development for many years and therefore this is not considered a new technique. However, Parsons will complete adequate sampling and analyses to ensure that all data collected are of the highest quality and reliability.

Reference measurements are collected on a material specific basis to determine background levels. Function checks using a multi- energy source are performed to insure that the instrument is identifying the proper energy level peaks.

The concepts of MARLAP are followed in this work plan in terms of utilizing qualified personnel, using calibrated and source checked instruments with proper documentation, documenting measurements, and as far as the additional concerns associated with being in the field. MARLAP also states that by using in-situ measurements the actual quantity and concentration of radionuclides can be assessed at the desired location without the bias that can be introduced by sampling. However, MARLAP is currently a draft document that is not used as for guidance because it is still being developed and is under review.

In order to demonstrate that the assumptions concerning horizontal and vertical distribution of radionuclides are accurate, validation of a volumetric source has been completed by the vendor using a multi-energy soil matrix source. Additionally, to maximize the counting efficiency of the system, the area of interest is scanned prior to collection of an in-situ gamma spectroscopy measurement to determine the highest location of gamma radioactivity, and this location is where the URSA is setup for data collection. This procedure is completed so that the area of interest is directly under the detector for maximum efficiency for evaluating the localized area.

It is not necessary for the NaI spectra to resolve all of the specific energy peaks within the pitchblende spectra, such as the uranium, thorium, and actinium series, from natural background in order to be able to determine the amount of radioactivity or to be able to confirm that the source of the reading is from something other then natural background or from the building materials, or if it is from pitchblende ore. The URSA will be able to assist in determining if additional investigation of a location is necessary based on the identified activity in comparison to the established DCGLs. The primary use of the URSA is to provide identification of the overall material and as a screening tool to determine where samples need to be collected for further investigation.

The multiple radionuclides that are of concern, in addition to all of the radionuclides of concern that are present in natural background, does complicate the evaluation. However, it is possible to identify the radionuclides of concern at SEAD-48, most particularly the Th-232 series, based on the variety of gamma emitting radionuclides that are associated with the pitchblende material. These radionuclides are contained in the natural background, however the DCGL will be exceeded if the source if from pitchblende. The spectrometer will be used to collect background spectra that will then be subtracted from the material spectra to determine if the activity is above established action levels.

Comment 3: The third concern with regard to the URSA is that the workplan does not indicate whether alternatives to in situ methods were considered. The final status survey could be performed without using in situ gamma spectroscopy. For outdoor survey units, the number of sample locations could be calculated using MARSSIM, and samples could be collected and analyzed in a laboratory. This would eliminate the need for in situ measurements outdoors, but would increase the number of laboratory analyses and probably increase the amount of time required to obtain the results of these analyses. For indoor survey units, relatively short in situ direct measurements could be performed using the gas proportional or phoswich detectors. The guidance found in NUREG-1507 could be used to develop efficiencies for these analytical protocols that would meet the measurement quality objectives (MQOs). This alternative could result in reduced costs and reduced time.

The use of in situ gamma spectrometry does not appear to be a requirement for this site. The capability of the surface scanning methods to demonstrate that there are no small areas of elevated activity would seem to be a more significant issue than determining the average activity over a large area at this site. If in situ gamma spectrometry is required to meet the objectives of this survey, the deciding issues will be related to cost and method validation. The URSA/NaI(TI)-based system requires significant effort to develop and validate site-specific detector efficiencies, with additional effort required to validate the software used to interpret the NaI(TI) spectra. The software validation should demonstrate that the complicated spectra expected for these measurements can be adequately and accurately resolved. The validation requirements for this system as well as the evaluation criteria should be developed and discussed in the workplan.

Response 3: In the letter sent to the agencies dated May 24, 2002 concerning the use of the NaI detector with the URSA, the intended capacity of the instrument was reiterated. In general, a large number if scanning and direct alpha, beta, and gamma measurements will be collected in the quantity necessary to satisfy the guidance of MARSSIM. For confirmation, material and soil samples for laboratory analysis are proposed. The URSA system is intended to be a interim step between the scanning/direct measurements and the laboratory analytical samples to be able to select the most appropriate samples to send for isotopic analysis, thereby reducing the number of laboratory samples necessary.

Specific Comments:

Comment 1: Page 1-5, fifth paragraph - "...Ludlum 19 G-M detector...": A Ludlum Model 19 utilizes a NaI scintillation detector, not a Geiger-Mueller (G-M) type.

Response 1: A Ludlum Model 19, which is a microR meter, does use a NaI detector. The MicroRem meter uses the Griger-Mueller detector. The historical document that the instrument information came from appears to have referenced the instrument incorrectly. It is suspected that a Model 19 was used to do the microR surveys for this radiological survey. The text will be changed to just read "Ludlum 19" and the detector type will be excluded.

Comment 2: Page 3-2, first paragraph – "A Ludlum model 43-68 hand-held scintillator probe (phoswich) will be used to perform the alpha-beta survey....": The Ludlum Model 43-68 is a gas proportional detector, not a phoswich type.

Response 2: The text has been corrected. The instrument to be used for the direct and scanning alpha/beta radiation surveys of the walls and the ceilings is the 43-1-1 plastic scintillation probe (phoswich).

Comment 3: Section 3.3.4, In-Situ Gamma Spectroscopy Surveys: It is not clear how in-situ gamma spectroscopy will assist in establishing that building surfaces meet a release criterion. At best, it seems that the gamma spectroscopy results will answer the question "Is this nuclide present?" Since the radioactive contaminants of concern are of the naturally occurring, the answer will always be "yes."

Further, for in-situ gamma spectroscopy to be of use for soil surfaces, the contamination must occur uniformly in the soil. The soil contamination at Seneca Army Depot does not appear to fit into this category.

The Universal Radiation Spectrum Analyzer may be of use in an onsite laboratory for sample screening, however, or even for soil sample analysis, if the analytical results meet the project data quality objectives.

Response 3: The spectrometer will allow for determination of if the DCGLs are being met and if the naturally occurring radionuclides are at background levels, from the building material, or if there is residual radioactivity present, and if so, what isotopes. The ability to be able to determine the answers to these questions assist in determining what samples should be sent to the laboratory for further isotopic analysis.

We disagre that the contamination in soil would need to be uniformly distributed in order for in-situ gamma spectroscopy to be performed. For in-situ gamma spectroscopy the soil does not need to be uniformly contaminated because gamma spectroscopy can be used for identification of a discrete radiologically contaminated mass within a soil matrix. Additionally, the area is scanned previously so that the detector is placed directly over the area with the highest reading.

Comment 4: Section 3.3.4, page 3-2, second paragraph: Text states that 5% of the samples will be sent to an approved off-site laboratory and that these data will be used to confirm and correlate the site results of the URSA. The Plan also states that the lab has not yet been selected. The lab should be selected and named in the workplan. Will the lab's QAPP be submitted for review? How will the lab data be validated? How will the data be correlated to the URSA results? What if the lab data do not confirm the URSA results?

Response 4: The laboratory to be used for all analytical analysis will be General Engineering Laboratories, Inc (GEL). In 1999, the Army went through a rigorous process with the NYSDEC and the EPA in getting approval to use this laboratory for radiological analyses. GEL can achieve the MDAs needed for the project. A table has been added to the work plan that compares the SEAD-48 DCGLs to the laboratory MDAs.

Comment 5: Section 3.3.6, page 3-3, second paragraph: Text states that all checks will be done using NIST-traceable radioactive sources. This is too vague. The reader is left to assume that the correct sources will be used. Please list the sources for each type of measurement. This is critical to ensuring that the field measurements are correct.

Response 5: A table has been added in Section 3.3.6 of the work plan that clarifies which NIST-traceable sources are used with the instruments for the field instrument function checks.

Comment 6: Section 3.3.7, page 3-4, second paragraph: Text states that "all potentially elevated locations will be further investigated..." How?

Response 6: Clarification on how to further investigate a potentially elevated location has been added to Section 3.3.7 of the work plan. Generally, if a location above the field flag value (see Table 3-3) is identified during the radiological survey, then more measurements are collected, as indicated in the hotspot field survey form in Appendix C.

Comment 7: Section 3.7, Page 3-7: There is no rationale for the placement of the six downgradient wells. How were the locations selected and why?

Response 7: The purpose of the wells is to determine if elevated radiological activity is present in the groundwater. The locations of the wells were chosen based on the direction of the groundwater flow and were placed proximate to the igloos that have Class I exterior survey units.

Comment 8: Section 3.3.2: Text recognizes that the MDAs are not always achievable with the FIDLER and refers the reader to Table 3-3. Footnote d) on the Table states that the static MDAs are below the DCGLs for the FIDLER and that the scanning MDAs are not. In fact, it appears that many of the static MDAs are not below the DCGLs, for the FIDLER and for the 3x3 NaI detectors. Table 3-3 needs to show that the DCGLs will be achieved and the text should clearly state how; for instance, will longer static times be used? If so, how long a reading is necessary to achieve the required MDA? How will longer readings affect the project schedule?

Response 8: The use of a FIDLER and ratemeter system that has an energy window ranging for approximately 50-250 keV will be used to lower the MDA below the DCGL that is required for a 1 minute static measurement. Refer to revised Table 3-4 for the appropriate MDAs for this setup. The text is clarified to indicate that such a system is required to meet the DCGLs.

Comment 9: Section 3.3.5, Radon Surveys: This section indicates that the radon levels of each igloo will be measured using an electret device. The results will be used to determine if radon concentrations exceed EPA standards. Has any thought been given to addressing the possible differences in interpreting radon concentration results based on pico-curie per liter measurements vs. a direct measurement of working levels (the EPA standard is written as 0.02 working levels)? The relationship between working level and radon concentration in air will vary based building air exchange rates. Typically radon concentration measurements are compared to the EPA guideline of 4 pCi/L for residential structures. The 4 pCi/L guideline is only applicable to residential structures. The air exchange rate for the igloos may such that this comparison is invalid.

Response 9: It is agreed that the 4pCi/L standard may be too conservative. The average Radon level in several background igloos will be evaluated against the Radon levels in the SEAD-48 igloos to determine if there is source, other then a naturally occurring source, that is present in the igloos.

Comment 10: Sections 3.4, 3.5, and 3.6, concerning Class I, II, & III surveys (quotations taken from page 3-4, section 3.4.1): I feel that there is a major point of confusion in these sections. There is discussion concerning 50-100% scanning surveys and direct measurements. The reviewer does not understand the relationship between grid sizing and the 100% coverage scanning surveys. They should be independent of one another.

It is understandable to make mention of grid spacing and frequency when discussing direct measurements and/or sample locations. To discuss surveying "100% of the following surfaces conducted in 2 meter by 2 meter grids at igloos E0804 through E0811..." confuses the issues of coverage.

If the survey will cover 100% of the surface, what does the grid sizing have to do with the scan? Further, how can a surface be surveyed over 100% of its surface "randomly in 1 meter by 1 meter grids?"

Response 10: Grids, which are set up as part of the established reference coordinate system, are established at the site to facilitate selection of measurement and sampling locations and to provide a mechanism for referencing a measurement to a specific location so that the same survey point can be relocated (MARSSIM, September 2000). The grid sizes are independent of the percent scanning coverage for each survey class; however, the grid sizes were included in the discussion to indicate that the surfaces will be scanned in 2 meter by 2 meter sections. The scanning is completed in individual grid sections to provide data for that grid (such as minimum and maximum scanning result) and to identify and be able to re-locate potential elevated measurements within the grid.

The word "randomly" in reference to locations of Class I scanning surveys has been removed.

Comment 11: Tables 3-1 and 3-2: Some of the soil DCGLs exceed radionuclide in soil levels previously agreed upon at other New York State uranium clean-up sites. Also, some of the derived building surface DCGLs appear to exceed levels published in the New York State Department of Labor regulations (12NYCRR, part 38, table 5).

Response 11: Soil DCGLs were developed in accordance with MARSSIM guidance by Argonne National Laboratories (ANL), the developer of RESRAD, following accepted protocol. For the development of the DCGLs for Soil refer to section 6.3 of Appendix B, *Seneca Army Depot Activity*

License Termination and License Release Plan, written by ANL. The NYSDOL standards are not applicable.

Comment 12: Table 3-3: A comment is made in item 3 of Parsons March 4 letter justifying the use of the URSA system that "The NaI-based system can produce results below the DCGLs for the building materials using a 60-70 minute count time." This is not shown in the work plan on Table 3-3. The MDAs for 60-70 minute count times are not shown, so the reader cannot tell from the workplan that the NaI detector system MDAs are less than the DCGLs. The workplan should stand alone and should be updated to include information in the supplemental documents. On Table 3-3, there appears to be a "5" next to "Windowed FIDLER", but there is no corresponding footnote 5. On Table 3-3, footnote d) states that " All areas potentially elevated above background will be further investigated." How? It also states that "....gamma measurements collected in the field will be supplemented with the collection of readings with alpha/beta radiation detection instruments." Why? Which DQO requires this?

Response 12: The work plan will be updated with information that was presented to the regulators in the March 4, 2002 letter and the May 24, 2002 letter.

In the revised Table 3-3 of the work plan, the footnote "5" after "Windowed FIDLER" has been corrected to reference footnote "e". Footnote "e" reads: Values presented are based on previous field experience using a closed energy window on the FIDLER with an energy range of 50-250 keV. Footnote "d" has been expounded upon as indicated in EPA Specific Comment 6.

The collection of alpha/beta radiation measurements are required due to the potential presence of Pormethium-147, which is an alpha emitting radionuclide. Additionally, collection of these measurements will provide a lower detection limit than gamma measurement alone.

Comment 13: Section 5.0, page 5-1: The text states that "All data shall be subject to verification and validation prior to use in the final report, including consideration of technical validity. This is too vague. The specifics should be included, unless they are covered in a QA document elsewhere; if so, that document should be referenced.

Response 13: Additional information is provided in Section 3.3.7 of the work plan regarding the data review process at SEAD-48.

Response to Comments from New York State Department of Environmental Conservation

Subject: Draft E0800 Row Pitchblende Ore Storage Igloos (SEAD-48) Work Plan
Seneca Army Depot
Romulus, New York

Comments Dated: April 10, 2002

Date of Comment Response: July 19, 2002

Specific Comments:

Comment 1: Page x. List of Acronyms: TAGM Stands for "Technical and Administrative Guidance Memorandum" not Chemical.

Response 1: The acronym has been corrected.

Comment 2: Page 3-2, Section 3.3.4, In-Situ Gamma Spectroscopy Surveys: As previously stated at the August 15th demonstration, and in agreement with the NYSDOH letter dated August 20, 2001, the NYSDEC does not accept the use of the URSA instrument as a replacement for normal accepted sampling practices, and/or accepted alternative methods. Until a more detailed evaluation can be made regarding its effectiveness, this unit should not be utilized in lieu of normal sampling of radiologically contaminated soils at the Seneca Army Depot.

Response 2: Based on the concerns raised at the August 15, 2001 demonstration at NYSDOH and in a letter from NYSDOH dated September 6, 2001, Parsons submitted a response to the agencies on March 4, 2002. Additionally, a follow up letter was issued to the agencies from Parsons on May 24, 2002 clarifying the intended use of the NaI based in-situ gamma spectroscopy system.

Figures 1 and 2 from the May 24, 2002 letter, which demonstrate how the URSA is used in the overall survey plan for SEAD-48, have been added to the work plan. In general, a large number of scanning measurements will be collected to satisfy MARSSIM requirements for a final status survey. A subset of the scanning measurements will be evaluated with the NaI-based URSA to aid in the selection of material samples to be analyzed at the laboratory for confirmatory sampling. The URSA does not replace analytical laboratory sampling, it just helps further define the locations where material samples should be collected.

Comment 3: Page 3-1, Section 3.2, Derived Concentration Guideline Level: NYSDEC's TAGM 4003 is incorrectly sited as TAGM 4006.

Response 3: This citation has been corrected.

Comment 4: Page 3-2, Section 3.3.2, Gamma Radiation Surveys: Since the radionuclides from pitchblende emit gamma energies in a broad range, a FIDLER probe is not appropriate for all surveys. The most appropriate instrument to utilize would be the mentioned 3X3 NaI detector since the energy range is greater, and the overall efficiency is also far greater than a FIDLER. The pitchblende which was stored in the igloos contains the entire Uranium chain, with a wide range of energies, not just lower end gammas.

Response 4: Disagree. While the 3"x3" NaI does detect a wider range of gamma energies, it has a higher minimum detectable amount (MDA) than the FIDLER because of higher background (as noted in Table 3-4 of the work plan). The primary radionuclides of concern all have a low-energy (< 200 keV) gamma emission: Ra-226 (186 keV), Th-232 (59 and 126 keV), U-234 (53 and 121 keV), U-235 (144, 163, and 186 keV), and U-238 (50 keV). The text and Table 3-4 have been revised to more clearly reflect this.

Comment 5: Page 3-2, Section 3.3.3, Exposure Rate Surveys: The narrative indicates that a "Ludlum MicroRem" meter will be utilized for exposure rate surveys. To our knowledge Ludlum does not produce such a tissue equivalent dose rate instrument. Bicron Instruments, however does manufacture such a device. Should the instrument utilized be a Sodium Iodide based Micro-R meter, manufactured by Ludlum or other, please be aware that such instruments tend to over-respond at low gamma energies, and can produce higher than actual exposure rates.

Response 5: The reference to a "Ludlum MicroRem" was in error. The instrument to be used in the SEAD-48 surveys to take exposure rate measurements will be a Bicron MicroRem. Changes have been made throughout the work plan to reflect this correction.

Comment 6: Page 3-3, Section 3.3.5, Radon Surveys: It is indicated that an E-perm electret devices will be utilized for ambient radon measurements. There are at least two types of these devices for passive radon sampling at short and long-term deployment intervals. Please specify which particular model will be utilized, and assure that it is the proper device for the deployment period.

Response 6: The short-term deployment E-perm electret will be used to measure ambient radon levels at SEAD-48. This clarification has been noted in the work plan.

Comment 7: Page 3-5, 3.4.2, Exterior Surveys:

A) It is stated that soil borings will be collected at locations determined by gamma scans. While this is useful, please be aware, when utilizing MARSSIM for final status surveys, the number and location of samples is systematically determined. Bias samples can provide additional information for determining if a hotspot will meet elevated measurement criteria, but MARSSIM uses a systematic approach to determination of the status of survey units.

B) Please explain the justification in dividing the borings into two foot sections. Also, a detailed explanation of the statement that "localized contamination would be treated separately" is needed.

C) The laboratory analysis indicated includes isotopes normally not reported for naturally occurring Uranium (U-233 and U-236). Please provide justification for analysis of these isotopes, and a breakdown of analysis protocols and associated detection limits, etc. for all radio chemical sample analysis.

Response 7:

A) As is stated in the work plan, soil borings would be collected at the each of the drain outlets and three others will be collected based on the gamma surface scans and biased with regard to the past remediation that was completed. This approach is based on the EPA Soil Screening Guidance for Radionuclides (EPA Publication 9355.4-16A) because MARSSIM does not provide guidance for subsurface surveys. The primary goal is to provide information to determine the presence or absence of subsurface contamination.

B) The sectioning of the borings was proposed to be consistent with the EPA Soil Screening Guidance for Radionuclides and allows the location of any contamination to be localized in the soil column. Additional clarification of the text has been added to explain how "localized contamination will be treated separately". Primarily, if elevated residual contamination is found it will be removed from the soil section and placed in a separate sample bag for further analysis. If an entire soil section is contaminated beyond the flag values, an additional soil boring will be made in the vicinity following the lowering of a 3"x3" detector into the borehole. These clarifications have been added to the work plan.

C) The analysis of U-233 and U-236 was a carry over from the previous radiological surveys conducted at Seneca. It is recognized that these isotopes do not belong in this list and they will be removed. Detection limits for the ROCs will be established at 10 times lower than the DCGLs and the primary analysis protocol will be gamma spectroscopy. These clarifications have been added to the work plan.

Comment 8: Table 3-1: The DCGL's listed include several radionuclides not associated with pitchblende. Is there reason to believe that any of these isotopes (H-3, Pu-239, etc.) might be present?

Response 8: There are radionuclides that were listed in Table 3-1 that are not radionuclides of concern at SEAD-48. This table has been revised to include only those radionuclides that are pertinent to the SEAD-48 investigation.

Comment 9: Page 3-8, Section 3.7, Groundwater Investigation: As per Section 24.3 of the Seneca Army Depot Federal Facilities Agreement, it should be stated in the document which "approved laboratory for isotopic analysis" will be retained by the Army for groundwater sample analysis.

In Section 2.0, the document lists Thorium as a radionuclide of concern, however the proposed groundwater investigation does not include Thorium as part of the proposed analysis. The groundwater samples should be analyzed for Th-232, Th-228 and Th-230 in addition to the listed isotopic analysis.

Response 9: The laboratory to be used for all analytical analysis will be General Engineering Laboratories, Inc (GEL). In 1999, the Army went through a rigorous process with the NYSDEC and the EPA in getting approval to use this laboratory for radiological analyses. GEL can achieve the MDAs needed for the project. A table has been added to the work plan that compares the SEAD-48 DCGLs to the laboratory MDAs.

As stated in Section 2.0 of the work plan, Th-232 is a radionuclide of concern at SEAD-48. Th-232, Th-228, and Th-230 have been added to the list of ground water analyses. Additionally, analyses for Th-232, Th-228, and Th-230 have been added to the building interior/exterior surveys. This change is reflected in the text.

Comment 10: NYSDEC would like the opportunity to take splits at a pre-agreed interval for MARSSIM samples, and perform confirmatory walkover surveys in all survey units.

Response 10: The Army will keep NYSDEC informed regarding the schedule so sampling efforts can be coordinated.

Comment 11: Page 7-1 indicates an April commencement to this work. Considering these comments, it would be prudent to discuss these comments and their resolution as soon as possible.

Response 11: Agreed. However, it should be noted that a revised estimated commencement to the SEAD-48 work is September 2002. This adjustment has been made in the work plan. The Army would like to arrange a call with the agencies to finalize the plan for work at SEAD-48.

Response to Comments from the New York Department of Health

Subject: Draft E0800 Row Pitchblende Ore Storage Igloos (SEAD-48)
and use of the Universal Radiation Spectrum Analyzer (URSA)
Seneca Army Depot
Romulus, New York

Comments Dated: May 29, 2002

Date of Comment Response: July 19, 2002

The New York State Department of Health (NYSDOH) recently provided comments to the NYSDEC on the above referenced document dated March 2002. Their comments are as follows:

The following comments refer to the draft work plan submitted by the U.S. Army Corps of Engineers for the interior surfaces and exterior soils of the E0800 row of igloos previously used to store pitchblende ore. Comments relating to the efficacy of utilizing the URSA system for isotope identification and measurement are not addressed.

General Comments:

The methodology proposed in the plan, following a MARSSIM protocol, is acceptable. There are, however, some problems in establishing individual isotopic DCGL's through the use of RESRAD. The suspected contaminant in this case is pitchblende ore which presumably was not processed in any manner thereby disturbing equilibrium. If that is the case, all of the uranium isotopes and their progeny would be present and contribute to the dose. DCGL's for surface contamination expressed as dpm/100 cm2, could require that each sample taken (swipe) and static measurement would need isotopic analysis, unless a percentage of the most restrictive DCGL value is applied as a flag to spur further analysis. This also holds true for soil contamination since the proposed wide area DCGL for Ra-226 is 0.343 pCi/g, (Table 3-1) which provides the entire 10 mRem/yr dose, yet all other isotopes would be present. This value would be almost impossible to attain since typical background values in NYS range above 1.0p/Ci/g for Radium and Uranium.

For interior surfaces, the fixed and removable limits as expressed in NYSDOL's Part 38, Table 5, may be more appropriate than the individual isotopic DCGL's. However, volumetric contamination of the walls and floors would require sampling and isotopic analysis and the DCGL's would then be applied.

Response: It is correct that pitchblende ore was not processed at SEAD-48 and that consequently, the equilibrium of the uranium isotopes would not have been disturbed. Therefore, Parsons developed gross DCGLs that have been calculated using the isotopic DCGLs of the significant radionuclides that may be present and the natural activity fractions for those radionuclides (see the revised Table 3-4 of the work plan). This was completed in accordance with Section 4.3.4 and using equation 4-4 from MARSSIM.

Gross DCGLs were calculated for both building surfaces and for soils as shown in Table 3-4 of the workplan. Calculating the gross DCGLs, which takes into account the actual ratios of the naturally-occurring radionuclides that may be present, allows the field survey measurements to be compared to the DCGL in real time, as opposed to sending samples for isotopic analysis. There will, however, be some laboratory isotopic analysis performed on material and soil samples as indicated in the work plan. Additional text has been added to the work plan to clarify the development and the use of the gross DCGLs.

Volumetric contamination of the walls and floors of the igloos is unlikely given the concrete construction and the nature of the materials stored there. However, if there is contamination below the surface of the building surfaces, it would be evident in the form of cracks and damage. This would then be detected with the instruments and if determined necessary, material samples could be collected and sent to the laboratory for isotopic analysis, as indicated in the work plan.

For the interior surfaces, MARSSIM guidance requires the development of the DCGLs to determine if the site meets the release criterion. These are developed based on radionuclide-specific activity concentrations using the isotopes that are known to be present. To determine if the site meets the release criterion, a conservative total effective dose equivalent (TEDE) of 10mrem/year is used (NYSDEC TAGM-4003. The NYSDOL standards are not applicable.

Specific Comments:

Comment 1: Page vi - The NYSDOH suggests using MARSSIM rev1, September 2000 rather than December 1997 as the Army's reference.

Response 1: The MARSSIM reference will be updated to reflect the most recent revision.

Comment 2: Page 3-2, Section 3.3.1 – This section refers to a Ludlum Model 43-68 probe as a scintillator phoswich when in reality it is a 100 sq. centimeter gas proportional probe.

Response 2: The text has been corrected to indicate that the phoswich scintillator (Model 43-1-1) will be used in the surveys.

Comment 3: Page 3-4 and 3-5, Section 3.4.1 describes the methodology of performing static one minute measurements in the center of each grid. It would be more appropriate to perform the static measurement at the location of the highest scan reading obtained in that grid for any of the measurements. As described, the static measurements could easily be taken in a clean area while the scan shows elevated activity. We would prefer having each of the static measurements made at the location of the highest individual (alpha, beta, gamma) scan locations.

Response 3: Direct measurements are collected to determine relatively uniform contamination. In Section 6.4.1 of MARSSIM the following guidelines are recommended: "Direct measurements may be collected at random locations in the survey unit. Alternatively, direct measurements may be collected at systematic locations and supplement scanning surveys for the identification of small areas of elevated activity."

The survey has been designed so that direct measurements are collected systematically in the center of each grid. The consistency of this design allows for more accurate documentation of the location of the direct measurements collected. If the scanning results indicate that any area of the grid is elevated above the field flag value then further investigation, including direct measurements, will be collected at that elevated location.

Comment 4: Page 3-5, Section 3.4.2 – This section describes methodology for obtaining 2-foot core samples in soil. Homogenizing a 2-foot sample for radiological analysis is not appropriate unless each 6-inch section of the core is sent for analysis. By definition, a surface soil sample is the top 6 inches while for radium and Thorium isotopes each succeeding 6-inch section would have it's own DCGL.

Response 4: Parsons soil sampling strategy is based on the guidance of Environmental Protection Agency (EPA) Soil Screening Guidance for Radionuclides (EPA Publication 9355.4-16A). This guidance is very similar to EPA Soil Screening Guidance (EPA Publication 9355.4-23) that is for chemicals. The main difference between the two guidance documents is the depth of surface soil. The guidance for radionuclides stipulates that the surface soil is 15 cm (approximately 6 inches); this is the value that will be clarified in the work plan.

This guidance "bases the decision to investigate a source area further on the highest mean soil boring contaminant concentration within the source, reflecting the conservative assumption that the highest mean subsurface soil boring concentration among a set of borings taken from the source area represents the mean of the entire source area" from Section 2.3.4.

Much of the surface is covered with asphalt, however, where surface soils do exist, the top 15 cm will be removed for further analysis. The rest of the process is the same as outlined in the work plan. For evaluation of the subsurface soils, the more conservative surface soil DCGLs will be applied for all samples collected.

Comment 5: Table 3-1 – Please note that the DCGL for radium is listed as 3.43 E-1 pCi/g. The NYSDOH also notes that Th-230 is not included in the list.

Response 5: The correct Ra-226 DCGL is given in Table 3-1. Additionally, Th-230, Pa-231, and Ac-227 have been added to the Table 3-1.

Comment 6: Table 3-2 – Please explain how each of the building surface (and volumetric) DCGL's for each of the isotopes listed will be identified using the alpha, beta, gamma instruments listed.

Response 6: The function of the survey instrumentation is not to identify specific radionuclide isotopes in the field. The purpose of the selected field instrumentation is to collect survey data for comparison against DCGL that has been derived using MARSSIM statistics. Specific isotopes will be identified based on limited laboratory analysis and possibly in-situ gamma spectroscopy where necessary if the DCGLs are exceeded.

Comment 7: Sections 5.4.2 and 5.5.1.2 have a conflict in the areas to be covered. Class 3 structures in 5.4.2 list no limit while 5.5.1.2 implies a limit of 1500 sq. meters.

Response 7: The sections identified above do not exist in the SEAD-48 work plan. In Section 2.1 of the SEAD-48 work plan it is stated that according to MARSSIM there is no limit recommended for the area of a Class III survey unit. Since there is no MARSSIM guideline for Class III survey areas, the survey design was set up as described in Section 3.6.1 of the work plan.

Comment 8: In a number of areas the "active" area of probe is listed. Is this the physical area or the open area?

Response 8: The work plan reports the open area of the detector. These values are identified in Section 3.3 and revised Table 3-4 of the work plan. A correction was made in Section 3.3.1 of the work plan due to an incorrect probe area being given.

Response to Comments on the
Draft Final Workplan for SEAD-48 (E0800 Row Pitchblende Ore Storage Igloos)

Response to Comments from the U.S. Environmental Protection Agency

Subject: Draft Final Workplan for SEAD-48
Seneca Army Depot
Romulus, New York

Comments Dated: August 22, 2002

Date of Comment Response: November 8, 2002

General Comments:

Comment 1: A skeleton of a QAPP has been added as Appendix D. The QAPP restates parts of the EPA reference documents, but does not provide the required information and is not adequate. The reader is simply referred to other documents. The QAPP should be written as a stand-alone document.

Response 1: A Generic Installation Remedial Investigation/Feasibility Study (RI/FS) Workplan for Seneca Army Depot (SEDA) was submitted in August 1995 and approved as final. This document, which includes a QAPP, serves at the generic workplan for all investigations at SEDA. The QAPP in Appendix D of the SEAD-48 workplan supplements the generic workplan, providing site-specific information and updating outdated references. Because the Army has already generated a QAPP for site investigations at Seneca as part of the Generic Installation RI/FS Workplan, Appendix D will be renamed "Supplemental QAPP" and will not be a stand-alone document. The document has, however, been revised to include more specific references and SOPs for the radiological survey instruments.

Comment 2: The "schedule" included in Section 7 is not adequate. It does not "...outline the target dates and the key milestones," as indicated in the Army's responses to comments. It is not adequate to evaluate whether the deadlines specified in the Federal Facility Agreement will be met. It also does not show deliverables and schedule review dates, which would allow the regulatory agencies to plan ahead for document reviews, critical meetings, etc.

Response 2: A revised schedule with document due dates and review periods has been added to Section 7.0.

Comment 3: The Army maintains its preference for selection of the URSA for in situ gamma spectrometry. However, the Draft Final document does not demonstrate that URSA-generated data will meet all the DQOs/MQOs, and that the resulting data will accommodate site-specific conditions and can be validated.

Response 3: The Army maintains its preference to use the URSA to perform in-situ gamma spectroscopy as a screening instrument to provide additional information in real-time and to be able to best determine the samples that have the highest potential for elevated radioactivity to be sent to the laboratory. Additional information had been added to the SOPs in Appendix D on the QA/QC of the URSA.

In the review of the MARLAP guidance, the majority of DQO/MQO requirements pertain primarily to laboratory analysis, as opposed to in-situ analysis. The conclusion was made however, that the DQO/MQOs for the URSA system are comparable to those of the other radiation detection field instrumentation proposed to be used in the SEAD-48 Final Status Survey because the URSA must also be able to identify the radionuclides of concern below the DCGLs. All spectra that are collected are analyzed with the URSA Multi-Channel Analyzer (MCA) software to provide a preliminary identification and quantification of the radionuclides present within the sample material. The generated output reports are then subjected to secondary analysis to evaluate the uncertainty and validity of the preliminary results. This secondary analysis is completed through examination of the MCA reports with particular scrutiny of the Full Width at Half Maximum (FWHM) values to validate the results. The FWHM evaluates the energy resolution of the spectra to determine if an energy peak can be used in the identification of the radionuclide. This validation process is detailed in the URSA SOP found in Appendix D of the SEAD-48 workplan. Additionally, confirmatory analysis at an off-site laboratory will be performed on approximately 5% of the material samples that are analyzed with the URSA.

Comment 4: There is no indication that the NRC has given final approval of the proposed DCGLs.

Response 4: The NRC has received the License Termination Plan for Seneca Army Depot and the DCGLs are still in the review process. Once DCGLs have been approved, an addendum will be added to the SEAD-48 workplan confirming their approval.

Comment 5: Regarding the monitoring wells, the text states that two wells are upgradient/cross-gradient, but the direction of groundwater and surface water flow is not indicated in the text or noted on Figure 3-4. As this information is critical to understanding the monitoring well placement, it should be included.

Previous EPA Specific Comment 7 had requested that a rationale for well placement be provided. Although Figure 3-4 was provided, and the Army stated that some wells were placed proximate to igloos that have Class I exterior survey units, not enough detail on the rationale was provided. Were the wells place equidistant around a certain feature, or were they placed where previous contamination was found, or just for easy drill rig access? Additional discussion should be provided.

Response 5: Groundwater flow directions will be added to the figure of proposed monitoring well locations. The locations of monitoring wells MW48-7 and MW48-8 were chosen because these wells are upgradient and cross gradient of the site. These two wells are to be used to provide site specific background data. Monitoring wells MW48-1, MW48-3, and MW48-4 were all placed along the drainage ditch that is proximate to the Class I exterior survey units at igloos E0804, E0806, and E0808. The area around these three igloos has the highest potential for residual radioactivity. A well was placed downgradient of the site at both ends of the drainage ditch (MW48-2 and MW48-6). These two wells are to be used to determine, if residual radioactivity is present in the groundwater, if the contaminated water has left the site. A discussion of the rational of the monitoring well placement will be added to Section 3.7.

Response to Comments from the New York State Department of Environmental Conservation

Subject: Draft Final Workplan E0800 Row Pitchblende Ore Storage Igloos (SEAD-48)
Seneca Army Depot
Romulus, New York

Comments Dated: August 20, 2002

Date of Comment Response: October 2, 2002

Specific Comments:

Comment 1: Page 3-2, Section 3.3.2: The document states that a FIDLER detector will be the main instrument for gamma surveys while the 3"x3" NaI detector will also be available. The FIDLER is to be windowed such that it can detect a range of 50-250 keV gamma rays.

While the radionuclides of concern (ROC) may have gamma energies within this range, gammas within this energy range are not as penetrating, and small amounts of soil cover (i.e., an inch or two) can attenuate these gammas significantly, thus reducing detection of radionuclides that may be near the detection limits.

Furthermore, since the material residue of interest is Pitchblende, *the complete decay chain for U-238, U-235, and Th-232 should be present.* Thus, there are several higher energy gamma rays which will be emitted by progeny such as Ac-228 (Th-232 series), Pb-214 and Bi-214 (U-238 series), Pa-234m (U-238 series), and Pb-211 (U-235 series). All of the mentioned radionuclides emit up to several high energy gammas which would be better detected should residual contamination at the surface or at depth, and should be in equilibrium with their parent nuclides as this material has been resident for several decades.

Response 1:
During the phone call on August 21, 2002, NYSDEC questioned the use of the FIDLER for this field effort, preferring the use of the 3"x3" NaI. They noted that the radionuclides of concern are associated with pitchblende ore, not just depleted uranium. NYSDEC feels that the 3"x3" NaI may be more appropriate for the outdoor survey since it can detect those radionuclides that would not be shielded by a thin soil cover. Parsons agrees that the 3"x3" NaI is appropriate to use for the outdoor survey. However, for the indoor survey Parsons still recommends use of the FIDLER, since the MDA of the 3"x3" NaI detector is greater than the DCGLs. It is highly unlikely that any residual radioactivity is embedded within the building walls and therefore, the FIDLER would be appropriate. The workplan has been revised to show the use of the 3"x3" NaI for the exterior scanning survey; as indicated in Table 3-4, the MDA is below the DCGLemc for the 3"x 3"NaI. The FIDLER will remain the primary instrument for the direct readings in the exterior survey because the FIDLER MDA is below the DCGLw, and the 3"x3" NaI MDA is not below the DCGLw. The instruments for the interior survey have not been changed.

Comment 2: Page 3-2, Section 3.3.3: Please explain the basis for arriving at the decision to make twice background the health and safety trigger for exposure rate surveys. This seems far too conservative, and may cause many unnecessary delays in work should such levels be encountered. There are set limits on exposure for radiation workers as prescribed in 10CRF20, and employers can further limit exposures through lower administrative limits. But this level (twice background) seems very inhibiting.

Response 2: The twice background value for the exposure rate surveys was chosen as a conservative action level that would require further follow up using the other instrumentation. The exposure rate surveys are used as initial screening of any potential contamination and to make sure that personnel are not exposed to high levels of radiation. Per the Parsons Corporate Health and Safety Plan, a level of 500 μrem/hr would require a work stoppage. The work plan will be clarified to reflect this procedure.

Comment 3: Page 3-6, Section 3.3.8: it is stated that boreholes will be logged for gamma radiation levels using the 3"x3" NaI detector. Please be aware that the borehole will need to be significantly larger than the detector, or problems such as lodged detectors can occur.

Response 3: As indicated in the workplan, a 3"x3" NaI detector, a FIDLER, and a GM pancake probe will be used to collect measurements from the boreholes. At the specified intervals, the soil boring will be obtained and these measurements will be collected outside of the soil boring to look for subsurface soil contamination. The new Figure 3-4 (Soil Boring Collection and Analysis Flowchart) in the workplan outlines the soil boring evaluation process.

Comment 4: Figures 3-1 and 3-2: What is the basis for the proposed number of analytical samples (two from max, per igloo interior, and three from max, exterior) to be taken from URSA measurements? MARSSIM has specific formulae for determining the number of actual samples, but no roadmap for partial alternative methods.

Response 4: It is correct that MARSSIM has specific formulae for determining the number of actual samples that need to be collected. This MARSSIM guidance was used when planning the survey and will be more clearly outlined in the workplan. The quantity of direct and scanning measurements, (for both interior and exterior surveys) exceeds the minimal sample requirement recommended by MARSSIM. The in-situ gamma spectroscopy measurements and the material samples for isotopic analysis are proposed to complement the data collected during the final status survey (FSS). Professional judgment was used in determining the number of in-situ gamma spectroscopy measurements and samples for analytical analysis to be collected to supplement the FSS. To determine the minimum number of direct measurement and surface soil samples, Section 5.5.2.2 of

MARSSIM was used. This calculation will be included in the revised workplan. The proposed number of surface soil samples is based on Soil Screening Guidance for Radionuclides (EPA/540-R-00-007, October 2000), which recommends taking "two or three soil borings located in the areas suspected of having the highest contaminant concentrations within the source."

Comment 5: Table 3-1, Soil DCGLw's for Residential Scenario. Please be aware that the DCGLw's for the radionuclides are not stand alone numbers. Combinations of the listed nuclides would need to meet the Sum of Ratios (SOR). For example, Radium-226 may be less than the DCGLw, along with several others, but the additive sum of the nuclide ratios to their respective DCGLw's may exceed unit. Also, there are no apparent soil DCGL emc's for the radionuclides listed. How will Parsons and the Army deal with small localized hotspots?

Response 5: The activity fractions provided in Table 3-1 were used to determine a gross activity DCGL; in determining the gross activity DCGL, the SOR was taken into account. Parsons has chosen to calculate gross activity DCGLs to determine compliance with the release criteria. This approach allows the field instrumentation to determine, without the need for isotopic analysis, if an area is above the DCGL requiring further remediation. The method for calculating gross activity DCGLs is outlined in MARSSIM section 4.3.4. The gross activity DCGLs that were calculated at SEAD-48 for natural uranium are: 1.5 pCi/g for soils, 1747 dpm/100 cm2 DCGLw, and 230,390 dpm/100 cm2 DCCLemc. This approach is consistent with MARSSIM guidance because the source of radioactivity (i.e., residual pitchblende ore) is known.

The $DCGL_{emc}$s are presented in Table 3-4. These values are the same for both the interior and exterior surveys for SEAD-48. Areas that exceed the field flag values based on these $DCGL_{emc}$s will be further investigated to determine if these areas are small localized hotspots. Investigation of the potentially elevated areas will consist of additional alpha, beta, and gamma direct measurements and gross alpha/beta/gamma swipes. If these measurements indicate that the area could contain elevated residual radioactivity, then an in-situ gamma spectroscopy measurement and possibly a material sample would be collected.

Comment 6: Army's Response to NYSDEC, Comment #7B: Contrary to what is stated in this response, the clarifications have not been added to the description of the collection of soil borings.

Response 6: The process of collecting soil borings at SEAD-48 has been further clarified by adding Figure 3-4, "Soil Boring Collection Flowchart". In addition, the Section 3 text has been updated based on revisions to the exterior survey methodology.

Comment 7: Page 10 of Response to USEPA Comments: Promethium-147 is mistakenly referred to as an alpha emitter, when in actuality it is a weak beta emitter.

Response 7: Agreed. However, Promethium-147 is not a radionuclide of concern at SEAD-48 and was inadvertently included in the text. Reference to Promethium-147 will be removed. Alpha/beta are proposed to determine the presence of the alpha and beta component of the pitchblende ore.

Response to Comments from the New York Department of Health

Subject: Draft Final E0800 Row Pitchblende Ore Storage Igloos (SEAD-48) Work Plan
Seneca Army Depot
Romulus, New York

Comments Dated: September 24, 2002

Date of Comment Response: November 8, 2002

General Comments:

The New York State Department of Health has reviewed the above referenced document and the proposed use of the Universal Radiation Spectrum Analyzer. Comments are as follows:

Comment 1: As pointed out numerous times at other survey units at the Seneca Army Depot site, the approach of using one survey to function as both the scoping and final survey is problematic.

Response 1: Numerous surveys at the site have previously been completed (see Section 1.3 Historical Surveys) providing ample data to provide a historical site assessment and characterize the site in order to perform a final status survey. The approach of combining multiple investigations to complete a final status survey is supported in MARSSIM where it is stated "Scoping surveys may be designed to meet the objectives of the final status survey such that that scoping survey report is also the final status survey report" (MARSSIM, Section 5.1). A similar approach was used for other areas at SEDA, including SEAD-12.

Comment 2: It is not acceptable to use the URSA system to quantify the activity of radionuclides. Radiological measurements of cores, soils, etc., should be conducted by an appropriately accredited laboratory.

Response 2: Figures 3-1 and 3-2 from the Draft-Final SEAD-48 Workplan illustrate that the URSA system is not used as a single method of quantification of radionuclides at the site. The approach illustrated in the figures is to use the URSA as an intermediate survey measurement to identify the samples with the highest activities to send for off-site analysis. Samples collected from the interior of the igloos and from the exterior surface soil and soil borings will be sent to an appropriately accredited laboratory for isotopic analysis.

Comment 3: A FIDLER detector is designed for measurement of low energy gamma photons. Isotopes, and their progeny, contained in pitchblende ore are better measured with a detector having a wider energy range detection capability. However, the comparison of concurrent measurements with a FIDLER and a 3" x 3" NaI detector may help you get a general assessment as to whether the contamination is superficial or is at depth. Use of the FIDLER alone is likely to underestimate the extent of subsurface contamination.

Response 3: For the interior gamma surveys Parsons prefers the use of the FIDLER because:

1. Residual contamination within the igloos, if present, is likely to be on the surfaces of the floors or walls, and not at depth;
2. Background noise associated with the FIDLER is less likely to drown out any residual radioactivity (i.e. the minimum detectable amounts of the FIDLER are lower than those of the 3"x3" NaI);
3. Gamma surveys are supplemented with alpha and beta surveys using a phoswich. This increases the number of radionuclides that can be detected.

For the exterior surveys, a 3"x3" NaI detector will be used for the gamma scanning surveys since subsurface contamination may be present under concrete or asphalt in particular. The MDA is below the $DCGL_{EMC}$ for the 3"x3" NaI, making this change complient with the MARSSIM guidance. The FIDLER will remain the instrument for collecting the direct gamma measurement because it has a MDA below the $DCGL_W$; the 3"x3" NaI does not have a MDA below the $DCGL_W$ so it can not be used for the direct readings. Section 3.0 of the workplan will be updated to reflect this change. It should be noted that there are advantages and disadvantage to both instruments. For example, a 3"x3" NaI detector is more efficient at identifying contamination at depth and is better at detecting higher energy gamma rays then the FIDLER. However, the FIDLER has advantages over the 3"x3" NaI because it is better at detecting the lower energy activities, which results in a reduction of background noise. These instruments used in conjunction with each other will provide reasonable survey data to support the final status survey.

Comment 4: There are numerous instances where the units of presumably microR appear as R.

Response 4: Parsons was unable to identify any instances where the units "R" were used. The confusion could be that "microR" was abbreviated as "uR", and this abbreviation was not included in the list of acronyms; it will be added to the list of acronyms.

<u>Specific Comments</u>:

Comment 1: <u>Section 3.3.2 Gamma Radiation Survey</u>: In regard to the statement that "A 3" x 3" NaI detector,..., will also be on hand." It is more appropriate to use a 3" x 3" NaI probe than a FIDLER for general gamma surveys.

Response 1: For the indoor surveys where contamination is not expected to be found at depth without also being located at the surface, Parsons feels that the FIDLER is an appropriate instrument to use in conjunction with the alpha/beta phoswich to survey for the radionuclides of concern. The workplan will be changed to reflect that a 3"x3" NaI will be used to perform the exterior gamma scanning survey and the FIDLER will be used to perform the exterior gamma direct measurements. Please see the revised Section 3 of the Final workplan that reflects these changes

Comment 2: Section 3.3.3 Exposure Rate Surveys: Setting your health and safety exposure rated at twice background may be considered to be a conservative precaution and is consistent with ALARA philosophy. However, it may not be a practical limit. No response is necessary to this item.

Response 2: Please refer to the response to the specific comment #2 in the comments provided by the NYSDEC on August 20, 2002.

Comment 3: Section 3.3.5 Radon Surveys: It is unclear how you equate radon activity to contamination, and to determine what, if any, remedial action is necessary.

Response 3: The radon testing will not serve to determine where remediation is necessary but rather to characterize the radon profile of the igloos. Because radon and uranium have similar progeny, a build up of radon in the igloos due to the igloos being closed up could lead to false positives. This potentially increased level of naturally-occurring radon may have an adverse effect on the alpha/beta measurements within the igloos. For example, if there are high alpha/beta measurements in an igloo, and there are high radon measurement readings, yet the gamma surveys and the material sampling do not indicate that residual pitchblende ore is present, then the radon tests would be used as one means of support that the radon is the cause of elevated alpha/beta measurements. Conversely, if there are elevated alpha/beta measurements but elevated radon activity was not detected, and the gamma surveys and the material sampling indicate elevated radiation, then the radon tests would be used to support that ambient radon is not the cause of the elevated radioactivity.

Comment 4: Section 3.3.6 Instrument Function Check Procedure: It is unclear as to what the following statement means: "All checks will be done using NIST traceable radioactive sources that are calibrated every two years." How is the NIST source calibrated, or what is meant by this statement?

Response 4: The phrase "calibrated every two years" will be removed from the text to avoid further confusion. The intent of this statement was to indicate that all radioactive sources to be used in instrument function checks are NIST-traceable and have been checked by an accredited laboratory using appropriate procedures every two years.

Comment 5: Section 3.3.8 Exterior Surveys, Class 1: With respect to soil borings, it is stated that in addition to a soil boring at each drain outlet, three additional borings will be made at biased location –

where past remediation was done. Please describe why borings will be limited to remediated areas and not others.

Response 5: Soil borings will be collected at each drain outlet (two per igloo) and at locations determined by the surface gamma scanning (the number of soil borings are dependent on the class of the survey unit). Of the exterior areas that have the highest gamma scanning measurements (with either the 3"x3" NaI or FIDLER) within a survey unit, those that received past remediation would receive preference in determining the locations of the soil borings - that is what is meant by "biased". These additional soil borings will not be limited to the previously remediated areas. The statement in the text will be clarified.

Comment 6: Section 3.3.8 Exterior Surveys, Class II: It is stated, "For every igloo, three URSA readings will be collected at the locations having the highest gamma readings." A sample should be collected for laboratory analysis rather than using the URSA unit, and again, the 3" x 3" NaI detector should be used.

Response 6: From the locations where in-situ gamma spectroscopy measurements are made, material samples will be collected at the highest locations and will be sent to the laboratory for isotopic analysis. For Class II exterior survey units, there are three locations where in-situ gamma spectroscopy measurements will be collected based on the location of the highest gamma scanning measurements; two of those locations will be co-located with the soil-boring locations. At a minimum, the surface soil samples from each soil boring will be sent for analytical sampling. Figure 3-4, a new figure added to the workplan, is a flow diagram illustrating the methodology of the exterior surveys. It should be noted that the use of in-situ gamma spectroscopy as part of the final status survey is not meant to replace off-site analysis. Rather, in-situ gamma spectroscopy is an additional survey instrument used to provide data for the final status survey. The work plan will be changed to reflect the use of the 3"x3" NaI in conjunction with the FIDLER for the exterior surveys, as explained in responses to NYSDOH general comment 3 and specific comment 1.

Comment 7: Section 5.9 Quality Assurance and Quality Control Measures: Use of the URSA is inconsistent with your QA/QC policy for radiological measurements.

Response 7: Additional QA/QC information on the URSA, including the SOP, has been added to the QAPP in Appendix D. The SOP details the QA/QC and the calibration procedures for the URSA.