DRAFT FINAL

Summary of the Radiological Survey Findings for the Iowa Army Ammunition Plant Explosive Disposal Area, Inert Disposal Area, Demolition Area / Deactivation Furnace, and Line 1 Former Waste Water Impoundment Area

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Formerly Utilized Sites Remedial Action Program

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Acronyms and Abbreviations

Ac	actinium
AEC	Atomic Energy Commission
ANSI	American National Standards Institute
Am	americium
BG	burning ground
Bgs	below ground surface
CERCLA	Comprehensive Environmental Response Compensation Liability Act
Ci/g	Curies per gram
cm^2	centimeters squared
cpm	counts per minute
Cs	cesium
CWP	contaminated waste processor
DA/DF	Demolition Area/Deactivation Furnace
DCGL	derived concentration guideline level
dpm	disintegrations per minute
DOD	Department of Defense
DQI	data quality indicator
DQO	Data Quality Objective
DU	depleted uranium
EDA	Explosive Disposal Area
EPA	Environmental Protection Agency
ft	feet
FUSRAP	Formerly Utilized Sites Remedial Action Project
GPS	Global Positioning System
HISS	Hazelwood Interim Storage Site
HP	Health Physics
IAAAP	Iowa Army Ammunition Plant
IDA	Inert Disposal Area
IDW	Investigation Derived Waste
IRP	Installation Restoration Program
K	potassium
L1FWWI	Line One Former Waste Water Impoundment
LAP	load, assemble, pack
LCS	laboratory control sample
m	meter
m/sec	meters per second
mrem/hr	millirem per hour
mrem/yr	millirem per year
MARRSIM	Multi Agency Radiation Survey and Site Manual
MDA	minimum detectable activity
MDC	minimum detectable concentration
MS	matrix spike
NAD	normalized absolute difference
NaI	sodium iodide
NORM	naturally occurring radioactive material
NRC	Nuclear Regulatory Commission

Acronyms and Abbreviations (Cont'd)

PA	Preliminary Assessment
PCB	polychlorinated biphenyls
pCi/g	picoCuries per gram
PE	performance evaluation
PIPS	Passivated Implanted Planar Silicone
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
QCSR	Quality Control Summary Report
Ra	radium
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
SAIC	Science Applications International Corporation
SAG	Sampling and Analysis Guide
SVOC	Semi-volatile organic compound
Th	thorium
TNT	2,4,6-trinitrotoluene
U	uranium
USACE	United States Army Corps of Engineers
UXO	unexploded ordnance
VOC	volatile organic compound
ZnS	zinc sulfide

1.0 INTRODUCTION / PURPOSE

A number of areas at the Iowa Army Ammunition Plant (IAAAP) in Middletown, Iowa were identified and defined within the *Preliminary Assessment: Iowa Army Ammunition Plant, Middletown, Iowa* (USACE, 2001a) as warranting further investigation for potential radioactive contamination. The areas warranting investigation were further defined in a letter from the Formerly Utilized Sites Remedial Action Program (FUSRAP) to the United Sates Environmental Protection Agency (EPA) Region VII, dated February 3, 2004 (USACE, 2004b). These areas are identified as the Explosive Disposal Area (EDA), the Inert Disposal Area (IDA), the Demolition Area/Deactivation Furnace (DA/DF), and the Line 1 Former Waste Water Impoundment (L1FWWI). It is these areas, the locations of which are generally shown on Figure 1-1, that are the subject of the radiological screening survey described in this report.

The radiological screening survey activities were performed by the St. Louis District of the United States Army Corps of Engineers (USACE) to investigate potential radioactive contaminants on the IAAAP site. The objective of the radiological screening survey was to collect sufficient radiological data to resolve whether or not the soil and man-made materials (i.e., pavements and floors around and within structures) present at the surface of the selected areas are radioactively impacted. If found to be impacted, the areas will require further investigation. If the areas were found not to be impacted, it is likely that no further action will be necessary in these areas.

Fieldwork for this survey was performed in August 2004 in accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE, 2004a) which was developed using the guidance provided in NUREG 1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) [Department of Defense (DOD), 2000]. The activities conducted during the fieldwork are documented in this report. Also presented are the results of the survey and analytical data generated for each of the selected areas (Section 5), and conclusions reached after evaluating the analytical results (Section 6).

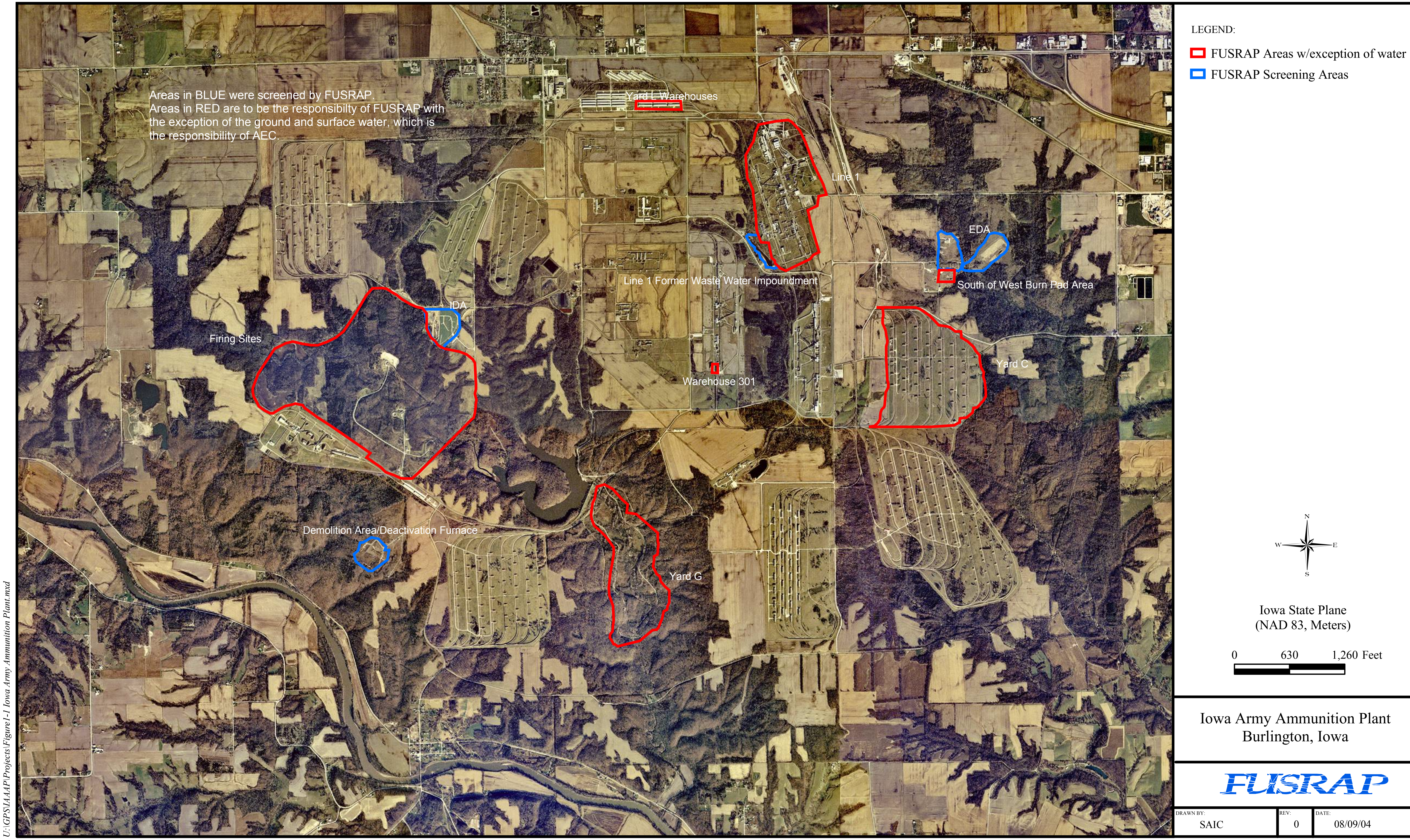

Figure 1-1. Iowa Army Ammunition Plant

2.0 SITE DESCRIPTION AND HISTORY

The IAAAP is owned by the United States Army and operated by a private contractor, American Ordnance, LLC. The IAAAP is located in the southeastern part of Iowa, near Middletown, approximately 10 miles west of the Mississippi River. It is a secured facility covering an area of approximately 19,100 acres in a rural setting. Approximately 7,700 acres are leased for agricultural use, 7,400 acres are forested and the remaining approximately 4,000 acres are used for administrative and industrial purposes (i.e., the plant areas). The topography of the IAAAP is roughly 60 percent flat and 40 percent rough and hilly. Flint Creek, Skunk River, and Spring Creek have portions of their watersheds on the facility.

According to the *Remedial Investigation/Risk Assessment, Iowa Army Ammunition Plant, Middletown, Iowa* (USACE, 1996), IAAAP was initially developed in 1941 and has undergone modernization and expansion since that time. Production of ammunition and explosives for World War II began at the facility in September 1941 and ended in August 1945. Production was resumed in 1949 and has continued to the present.

The ammunition items that are loaded, assembled and packed at the IAAAP include projectiles, mortar rounds, warheads, demolition charges, anti-tank mines, anti-personnel mines, and the components of those munitions, including primers, detonators, fuses, and boosters. The load, assemble and pack (LAP) operations use explosive material and lead-based initiating compounds. Only a few of the existing production lines are in operation.

Historical research revealed that portions of the IAAAP may contain radiological contamination from activities that supported the nation's early atomic energy program. The Atomic Energy Commission (AEC) conducted operations beginning in 1947, when a portion of Line 1, the EDA, Yards C, G, and L, and the Firing Site areas came under the control of the AEC and their contractor. These areas occupied approximately 1,630 acres within the IAAAP. In addition, the IDA and the DA/DF may have the potential for radiological contamination because they received materials from these areas used by the AEC. In accordance with the IAAAP Radiological Survey Plan (USACE, 2004a), four distinct areas were addressed in this survey. These areas are described in the following sections.

2.1 EXPLOSIVE DISPOSAL AREA (EDA)

2.1.1 Explosive Disposal Area Description

The EDA is an irregularly shaped area that includes the North Burn Pads Landfill, the North Burn Pads, the East Burn Pads, the West Burn Pads Area, and the area south of the West Burn Pads Area. The EDA is surrounded by predominantly forested land, which generally lies adjacent to the various drainages. Based on the observed topography of the area, surface-water flow from the EDA appears to drain toward and eventually into the area's main creek which flows north to south located between the West Burn Pads Area and the East Burn Pads. The general layout of the EDA is shown on Figure 5-1.

The northern portion includes the area generally bounded by the tree line north of the Contaminated Waste Processor (CWP), the north-south access road to the west, the east-west running creek to the south, and the wooded area to the east.

The eastern portion of the EDA includes the area enclosed by the fence in the east burn pads area, portions immediately outside the fence, and the area between the east burn pads and the main north-south running creek that separates the east burn pads area from the west burn pads area.

The western portion of the EDA includes the area of the west burn pads generally bounded by the east-west running creek that separates the north burn pads area from the West Burn Pads Area; the north-south running creek that separates the East Burn Pads area from the West Burn Pads Area; the east-west access road leading to the East Burn Pads and the north-south access road that leads towards the CWP.

The southern portion of the EDA includes the area south of the east-west access road that leads to the East Burn Pads area, the north-to-south running creek, the east-west road that provides access to Burning Ground-4 (BG-4) bunker, and the north-south access road leading towards the CWP.

The planned radiological screening was conducted in the above-described areas with the exception of the immediate area of the CWP located in the northwest portion of the EDA. This area has undergone several remediation and construction events which would limit or negate the effectiveness of a surface-based survey. In addition, this area was undergoing heavy construction/demolition activities at the time of the survey and was therefore considered inaccessible due to safety considerations.

At the time of the survey, the majority of the EDA areas were heavily covered with herbaceous vegetation. The north-to-south running creek that bisects the EDA was lined with trees and other woody species.

2.1.2 Explosive Disposal Area History

Historical records confirm the presence of depleted uranium (DU) in at least a portion of the waste burned or disposed in the EDA by AEC. Historical records indicate that a measurable amount of radiation was noted when performing a radiological screening of the residual ash from the various burn areas during the disposal operations. The active areas within the EDA have been remediated for chemical contaminants with confirmation chemical sampling performed in the excavation. No radiological screening or survey result summaries reviewed from the remediation phase of this area reported elevated levels of radioactive material. The monitoring wells located adjacent and down gradient of the EDA have shown no increased levels of uranium in the groundwater.

The EDA was referred to as the Burning Grounds in early histories and in 1941 was located on a portion of the East Burn Pads. The Burning Ground was expanded sometime in the late 1940s to include the area currently known as the West Burn Pad Area. The Burning Ground was designed for the disposal of waste that was contaminated by explosive material generated at the plant. The material was initially placed in small shallow pits and ignited from a remote shelter by a blasting machine. The standard practice at the time was to segregate any ash residue containing excessive alpha contamination after burning, then bag the residue, and ship it to the Pantex, Texas site for disposal. Ash not containing excessive alpha contamination was ultimately disposed of in three landfill cells at the IDA (USACE, 2001a).

The East Burn Pads were comprised of eight raised earthen burning pads, each of which was bermed on three sides. The East Burn Pads were enclosed within a 4.9-hectare fenced area. The East Burn Pads were used by AEC for the open burning of explosives-contaminated metals, including DU, pyrotechnic, and propellant-explosive contaminated materials.

The West Burn Pads Area, includes the West Burn Pads, West Burn Pads Landfill, Burn Cages, and Burn Cage Disposal Area (consisting of two burn pads measuring approximately 15 meters (m) by 5m), and a landfill measuring approximately 70 m by 91 m. The West Burn Pads were used by the AEC and the Army to rid metal parts of explosive contaminants. The process of ridding the metal parts of explosive contamination was by flashing the metal parts to burn away any residual explosive contaminants. Ashes generated from these operations and from the East Burn Pads were placed in the West Burn Pads landfill.

The West Burn Pads were remediated by the Army in 2000 as part of the Installation Restoration Program (Department of the Army, 2002). The Interim Record of Decision (ROD) (USACE, 1998) required the removal of contaminated soil from the West Burn Pads; however, a pre-design characterization of the soil found significant levels of previously undetected contamination that also required remediation by removal. The additional soil removal from the West Burn Pads was completed in 2001 and treated for barium contamination. No radioactive materials were discovered during a gross radiological screening performed during the remediation and the remediated soils were disposed of at the IDA.

From 1968 to 1972, the approximately 0.3-hectare North Burn Pad Landfill received wastes, reported to be flash cans and containers, from the North Burn Pad. Cleanup operations were performed in 1980 and 1998 that resulted in 9,175 cubic meters of North Burn Pad Landfill materials being removed, transported, and placed at the IDA (USACE, 2001a). A Site Investigation performed in 1991 did not indicate significant contamination; however, the Remedial Investigation (RI) completed in 1996 found metals in the soil and groundwater. Pre-design characterization activities conducted in 1997 and 1998 found high levels of explosives in the soil and leachate. Material was subsequently removed in 1998 and placed in trenches 6 and 7 at the IDA.

2.2 INERT DISPOSAL AREA (IDA)

2.2.1 Inert Disposal Area Description

The IDA covers approximately 8 hectares and included a trench-and-fill sanitary landfill, a burning ground, a metal salvage operation, a sludge lagoon, a waste-water sludge drying bed, and an earthen-bermed holding area formerly used to store sludge. Trenches 1 through 5 were capped by the Army Installation Restoration Plan (IRP). The general layout of this area, for the purposes of this report, is shown in Figure 5-2. The physical extent along the north, east, and southeast is the IDA perimeter road and along the southwest is the forested area of the various firing sites.

Trench 6 is approximately 200 m by 50 m and contains a storm-water sump area at the southern end. It was observed that the trench was surrounded by geosynthetic-lined berms to contain the deposited material. In general, the depth of material placed in this trench appeared greater in the northern end than in the southern end. Discussion with IAAAP personnel indicate that the trenches were filled from north to south. The southern portion was used for the collection of runoff and leachate which was subsequently treated and released. Vegetation growth within the trench was limited, but some areas of significant herbaceous vegetation were present.

Trench 7 is approximately 120 m by 75 m and also contains a storm-water sump area at the south end. This trench also appeared to be surrounded by geosynthetic-lined berms to contain the deposited material and is underlain by a geosynthetic liner. Similar to Trench 6, the depth of material placed in this trench appeared greater in the northern end than in the southern end and a runoff collection sump was present in the southern end. Vegetation growth within this trench was very limited, with only a few areas of significant vegetation.

The cap extension area is approximately 275 m by 60 m and is located in the southeast portion of the IDA, just inside the main entrance gate. This above-grade feature is characterized by relatively steep side slopes that are primarily covered with herbaceous vegetation. The top of the cap extension area is fairly flat and exhibits a variety of visible cover materials including bare soil, thick vegetation, and a geosynthetic liner. Current plans indicate that the cap extension area will be capped in the future.

2.2.2 Inert Disposal Area History

The IDA included a trench-and-fill sanitary landfill that operated from 1941 to 1992, a burning ground, a metal salvage operation, a sludge lagoon that was closed in 1984, a waste-water sludge drying bed, and an earthen holding area formerly used to store sludge.

The IDA, including Trench 6, Trench 7, and the cap extension area, is currently used as the depository for chemically contaminated soils from other sites on the IAAAP. DU contamination was potentially deposited at the IDA when soils from the West Burn Pads Area, East Burn Pads, North Burn Pads, North Burn Pads Landfill, L1FWWI and the Fire Training Pit were placed in Trench 6, Trench 7, and the cap extension area. Soils will be treated in Trench 7. Treated soils will be disposed and capped in Trench 6 and possibly in Trench 7. The cap extension area will also be capped.

2.3 DEMOLITION AREA/DEACTIVATION FURNACE (DA/DF)

2.3.1 Demolition Area/Deactivation Furnace Description

The DA/DF area is approximately a 4-hectare parcel located in the southwestern portion of the IAAAP and was used for open detonation of ammunition items that required immediate disposal. The Deactivation Furnace includes a feed area and retort system measuring 8 m by 30 m. An adjoining air pollution control system measures approximately 6 m by 8 m and includes a cyclone filter, a baghouse, fans, and an exhaust stack. The furnace was used to destroy small explosive-loaded components such as detonators, primers, and fuses. The general layout of this area, for the purposes of this report, is shown in Figure 5-3. The physical extent of this area is the open field to the east, and the tree line along the north, south, and west. This area is relatively flat or gently sloping in the open areas with an eroded area at the extreme northwest corner of the area. This area lies next to an open field to the east and tree lines to the north, south and west.

At the time of the survey, the Demolition Area was densely covered with herbaceous vegetation while the drainage ditch that separates the Demolition Area from the Deactivation Furnace was heavily wooded. The immediate area surrounding the Deactivation Furnace was also heavily vegetated to the tree lines located to the south and west.

2.3.2 Demolition Area/Deactivation Furnace History

The Iowa Department of Natural Resources allows the open detonation of ammunition items that require immediate disposal due to safety considerations, such as ammunition rounds that become armed during assembly. Since the early 1940s, the 4-hectare Demolition Area was used for open detonation of rejected ammunition. Currently, it is used only in an emergency. The Deactivation Furnace was used beginning in 1971 and was closed under a Resource Conservation and Recovery Act (RCRA) closure in 1995. The furnace was used to dispose of small explosive-loaded components such as detonators, primers, and fuses. The metal casings were recovered and sold as scrap; the ash from these operations was stored in drums as hazardous waste.

No historical records reviewed confirmed the presence of actual AEC activities in these areas. However, interviews with former workers indicated that an AEC sign was present on the Deactivation Furnace building in the past. Due to the fact that the furnace was in operation during the time frame of AEC activities at IAAAP, the purpose of this area, and the presence of the AEC security sign, the Preliminary Assessment (PA) concluded that this area warranted further field investigation for potential radioactive contamination.

2.4 LINE 1 FORMER WASTEWATER IMPOUNDMENT (L1FWWI)

2.4.1 Line 1 Former Wastewater Impoundment Description

The L1FWWI is an area of approximately 3-hectares that lies adjacent to the extreme southwest corner of the Line 1 area and includes the impoundment from the north dam to the south dam. This area is no longer used as a wastewater impoundment and was remediated in a Comprehensive Environmental Response Compensation and Liability Act (CERCLA) response action in 1997. The general layout of this area is shown on Figure 5-4. The area extends from approximately 91 m north of the north dam, then runs along the Line 1 perimeter fence to the east, then runs along the perimeter road beyond the south dam to the south, and along the north-south access road on top of the west earthen berm to the west.

At the time of the survey, several feet of water were present in the impoundment basin. Soil at the edge of the water exhibited saturated characteristics. The portions of the study area upstream of the north berm and downstream of the south berm were densely covered by primarily herbaceous vegetation. The slope from the eastern portion of the impoundment basin to the Line 1 western perimeter fence was also heavily covered with herbaceous vegetation. Based on the topography of the area east of the impoundment basin, it appeared that the surface-water from a portion of the Line 1 area drained toward and eventually into the waste-water impoundment basin.

2.4.2 Line 1 Former Wastewater Impoundment History

From 1948 to 1975 the AEC operated Line 1, which was the first production facility for manufacturing of high explosives components for weapons under the AEC. The line also reportedly generated the largest volume of waste-water at the IAAAP during that period. The waste-water was contaminated by waste from the manufacture of explosives [primarily 2,4,6-trinitrotoluene (TNT)], condensate from a coal fired power plant, and coal pile runoff. The waste-water was collected in clarifiers, and the effluent was discharged through a system of ditches into an impoundment. Fly ash was added periodically to the impoundment to absorb explosives. This impoundment was formed in 1948 by damming an upper reach of Brush Creek and named the Line 1 Waste Water Impoundment. The impoundment was used as a settling pond where excess particulate matter could settle prior to discharge during periods of heavy rain. The nominal size of the impoundment was approximately 1.5-hectares and extended approximately 396 m upstream from the dam. During periods of high flow the impoundment may have enlarged to about 3-hectares and extended as much as 732 m upstream of the dam. The dam was operational until it was breached in 1957. An Interim Response Action was completed in 1997 when explosives-contaminated soils were excavated from the area and transported to the IDA. No records have been found that indicate a radiological screening was performed. The site has been converted into a wetlands aimed at phytoremediating the surface and ground water contaminated by residual explosive contaminants.

Historical records indicate that there was a potential for DU and tritium releases to the environment from Line 1 AEC activities. The records indicate that the explosive contaminated effluent from Line 1 was sent to clarifiers for settling of the heavy particulates. The diluted effluent was then discharged to the Line 1 Impoundment. Radiological screening or survey result summaries have confirmed the presence of depleted uranium in a portion of the buildings at Line 1. No evidence of other radioactive material was identified during the historical radiological surveys. Historical records also indicate that 0.006 curies of elemental tritium was released per year to the atmosphere/environment; however, elemental tritium in a gaseous form would not be a contaminant because the documented releases were well below effluent release limits, tritium rapidly disperses into the environment, and the half life of tritium is relatively short. The plausible means of radiological contamination within this area would have been due to residual DU in the diluted effluent discharged from Line 1 or due to storm-water runoff carrying DU contamination from areas adjacent to the Line 1 buildings. The DU fines present in the initial effluent should have settled as heavy particulates and been transported to the IDA for disposal. The remediation of the impoundment would have removed the majority of any accumulated DU sedimentation from the effluent or storm-water runoff.

3.0 SURVEY IMPLEMENTATION

The activities performed during the radiological survey included gamma walkover surveys, soil sampling, and investigation of structures located in the EDA, IDA, L1FWWI, and the DA/DF. Survey activities were conducted in accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE, 2004a).

The specific data quality objectives (DQOs) established for this survey and DQO attainment are presented in Table 3.1. A more detailed discussion regarding the data quality is presented in the Quality Control Summary Report (QCSR) in Attachment A.

Table 3.1 Data Quality Objectives

DQOs	DQO Attainment
Quality Assurance/Quality Control (QA/QC) split and duplicate soil samples will be collected at a frequency of at least 1 in 20.	QA/QC split and duplicate soil samples were collected at a frequency of 1 in 18 (4 of 70).
Precision will be determined by comparison of split and duplicate sample values with an objective relative percent difference (RPD) of 30% or less at 50% of the criterion value when reported activities are >5 times their minimum detectable activities (MDAs); if samples are <5 times their respective MDA, the normalized absolute difference (NAD) will be used with an objective NAD <1.96.	RPD and/or NAD values for all analytes were within the ±30% window of acceptance for the verification samples.
Soil sampling data generated by the analytical laboratory will undergo data verification and validation with a project goal of 95% data usability.	The soil data achieved greater than the project goal of 95% data usability. 100% of the data is usable.
Target MDA for gamma spectroscopy will be <1picoCurie per gram (pCi/g) potassium (K)-40, <5 pCi/g uranium (U)-238, and 0.5 pCi/g U-235.	The target MDA for gamma spectroscopy was met for K-40 with 0.6702 and U-238 with 1.227. Six U-235 sample analyses exceeded the target MDA of 0.5 pCi/g, the highest having a value of 1.408 pCi/g. These exceedances have no significant impact on the overall data usability for the following reasons: • Samples were also analyzed by alpha spectroscopy (a generally more sensitive analytical method). Target MDAs for samples analyzed by alpha spectroscopy were met for each sample as discussed below. • Data generated using alpha spectroscopy is used in the data tables in Section 5. • Analysis of samples by gamma spectroscopy was primarily used to provide data for the non-DU radionuclides. • The associated DU radionuclides (i.e., U-234 and U-238) confirm that all samples yield results well below the 56 pCi/g screening level.
Target MDA for alpha spectroscopy will be 1.0 pCi/g for U-238, U-235, U-234.	The target MDA for alpha spectroscopy was met for U-238, U-235, and U-234 with the highest values being 0.438, 0.5749, and 0.5177, respectively.
A minimum of 12 random samples will be collected in each designated area.	Twelve samples were collected in each designated area, with the exception of the EDA, where 24 samples were collected.
All radiological survey equipment will be operated and maintained by qualified personnel, in accordance with Science Applications International Corporation (SAIC's) Health Physics Program procedures.	All radiological survey equipment was operated and maintained in accordance with Health Physics (HP)-30 Radiological Instrumentation of SAIC's Health Physics Program procedures.
Gamma walkover data will be electronically recorded and visually displayed in color-coordinated maps.	Color-coded maps were produced for this document from electronically stored gamma walkover survey data.
Beta scan data will be recorded on standard survey forms in accordance with SAIC's Health Physics Program procedures.	Beta scans were recorded on Attachment 1 per HP-11 Radiological Monitoring in accordance with SAIC's Health Physics Program procedures.

Table 3.1 Data Quality Objectives (Cont'd)

DQOs	DQO Attainment
Beta fixed point minimum detectable concentration (MDCs) will be 3000 disintegrations per minute (dpm)/100 centimeters squared (cm^2) or less than 50% of the screening level.	Actual Beta fixed point MDCs were 537 dpm/100cm^2 or less, which is less than 50% of the screening level.
Alpha fixed point MDCs will be 300 dpm/100cm^2 or less than 50 % of the screen level.	Actual Alpha fixed point MDCs were 291 dpm/100cm^2 or less, which is less than 50% of the screening level.
Beta scan MDCs will be 4000dpm/100cm^2 or less than 80% of the screening level.	Actual Beta scan MDCs were 966 dpm/100cm^2 or less, which is less than 80% of the screening level.
Ludlum 2929 alpha contamination MDA will be 60 dpm/100cm^2 or less than 10% of the screening level.	Actual Ludlum 2929 alpha contamination MDA was 14.89 dpm /100cm^2, which is less than 10% of the screening level.

3.1 GAMMA WALKOVER SURVEYS

Gamma radiation walkover surveys were performed using a Ludlum Model 44-10 2" x 2" sodium iodide (NaI) gamma scintillation detector coupled with Trimble® Global Positioning System (GPS) units. Surveyors advanced on-foot at a maximum speed of approximately 0.5 meters per second while passing the detector approximately 4 to 6 inches over the ground surface in a serpentine pattern. Scanning results were electronically recorded once per second in counts per minute (cpm). Audible response of the meters was monitored during scanning.

In general, the gamma walkover surveys concentrated on low points or areas expected to have the highest likelihood of radiological contamination while those areas that were remote or less likely to be contaminated received a less intense survey. This approach, in accordance with standard practice, concentrated the greatest effort in the areas of highest risk potential while still providing coverage of other portions of the subject areas with lower risk potential. Additional area-specific discussion of gamma walkover survey findings and results are included in Section 5.

Radiological survey readings can be affected by several localized phenomena including, but not limited to, precipitation, barometric pressure, topography, ground surface geometry, and small differences between the multiple meters used during such surveys. Readings can also be affected when equipment cables become entwined with dense vegetation or when meter probes strike stalks, roots, or rocks. Therefore, locations where initial walkover data indicated the potential presence of elevated radiological activity were further investigated to determine if the initial readings were reproducible and sustained. This further evaluation consisted of concentrated gamma walkover surveys in the immediate area of the initial anomaly and was conducted either at the time of the original survey or subsequent to the original survey. After such re-evaluation, locations that exhibited reproducible and sustained readings were sampled if the location was not represented by previously obtained samples taken from that or a similar area.

3.2 SOIL SAMPLING

Soil sampling associated with this survey was conducted at IAAAP in August 2004 in accordance with the radiological screening plan (USACE, 2004a). Samples were obtained from the soil surface in the EDA and the DF/DA. To address the potential of both surface and subsurface contamination, some locations in areas of the L1FWWI and the IDA were sampled to a maximum depth of approximately two feet (ft) below ground surface (bgs).

At the L1FWWI, remediation of the impoundment basin occurred in 1997. Therefore, six of the twelve randomly-located soil samples were obtained from the 6-inch to 12-inch bgs interval in order to target sediment that would most likely contain historical radioactive contamination while avoiding surface sediment that has accumulated since remediation was conducted.

At the IDA, twelve randomly placed soil samples were obtained from Trench 6 and Trench 7. The depth of the soil sampled at each location was also randomly determined from each discrete

6-inch interval from the surface to approximately 24-inches bgs such that each interval was sampled at least once. In accordance with the radiological survey plan, this random depth approach was designed to increase the probability of detecting radiological contamination that may have been deposited in the trenches.

Surface soil samples were obtained using pre-cleaned stainless steel trowels and bowls. Pre-cleaned hand augers were used to obtain subsurface soil samples. Soil samples were homogenized in stainless steel bowls and field-screened for radioactivity using a Ludlum 2221/44-9. Soil samples were then placed into 1-quart steel sample cans.

The following excerpt from the Iowa Army Ammunition Plant Radiological Survey Plan (USACE, 2004a) explains the derivation of the DU screening level :

> *"NUREG 1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* [Nuclear Regulatory Commission(NRC), 1998] lists the MDC for scanning with a 2" x 2" NaI detector for soil contaminated with DU at 56 pCi/g. It has been determined that this level of contamination will be detected at least 95% of the time by the average survey technician walking at a rate of 0.5 meters per second (m/sec). This scan MDC value is based on the assumption that instrument background is at or near 10,000 cpm. Site-specific background for instruments used during the walkover survey should be within ± 20% of this value to validate the use of the stated scan MDC. If instrument backgrounds fall outside this value, a site-specific scan MDC should be calculated.
>
> Conservative risk and dose assessment calculations were performed using the residual radiation code (RESRAD) 6.0 to model a residential scenario with DU soil contamination at 56 pCi/g. The resulting risk and dose to the maximum exposed individual from this evaluation is 5 E-5 and 8 millirem per year (mrem/yr), respectively, as described in Appendix A, *IAAAP Survey Screening Level DCGL Risk/Dose Assessment.*
>
> The use of 56 pCi/g as a screening level for DU is applicable to IAAAP since it is expected that the soil at these sites is potentially contaminated with micron-size DU particles. In this situation, it is expected that the activity per gram of soil is much less than the known specific activity of solid DU (i.e., 3.637 E-7 Ci/g). For solid DU (i.e., visible DU fragments), the specific activity is known and the appropriate parameter to define the minimum detectable quantity is the size of the fragment, not its activity.
>
> The presence of DU in excess of 56 pCi/g in any sample from a specific area will require additional investigation for that area or the affected parts of that area. If no samples from a specific area contain DU in excess of 56 pCi/g, no further action will be required in that area" (USACE, 2004a).

Soil sample results were compared to the established DU screening level of 56 pCi/g. Further discussion of the soil sampling findings and results is presented in Section 5.

3.3 ANALYSIS OF SOIL SAMPLES

Collected soil samples were sent to the USACE-validated FUSRAP Radioanalytical Laboratory located in Berkeley, Missouri and analyzed in accordance with the *FUSRAP St. Louis, Laboratory Quality Assurance Plan and Laboratory Procedures Manual* (SAIC, 1999).

The samples were processed for alpha spectroscopy analysis to determine isotopic concentrations of the three uranium isotopes present in DU (U-238, U-235 and U-234). Prepared samples were chemically processed using the Claude Sills method of chemical separation and were counted on a Canberra alpha spectroscopy system equipped with Passivated Implanted Planar Silicone (PIPS) detectors. Samples were counted in an attempt to achieve a detection sensitivity of 0.1 pCi/g for each isotope. The split samples collected were analyzed by alpha and gamma spectroscopy by Severn Trent Laboratories.

In addition, samples were dried, homogenized, and analyzed for gamma emitting isotopes using Marinelli beaker geometry and a Canberra gamma spectroscopy system. Sample results were reported for the standard FUSRAP library of contaminants (actinium(Ac)-227, americium(Am)-241, cesium(Cs)-137, potassium (K)-40, radium (Ra)-226, Ra-228, thorium (Th)-228, Th-230, Th-232, U-235, U-238) and other peaks if identified during the analysis. Samples were counted in an attempt to achieve an MDA for K-40 of 1 pCi/g resulting in typical detection sensitivities for U-238 and U-235 of approximately 3 pCi/g and 0.2 pCi/g, respectively.

Validated sample data with qualifiers for both alpha and gamma spectroscopy analysis are presented in Attachment B.

3.4 BUILDING SURVEYS

Building and structure surveys were limited to those structures that could be accessed safely. Three different types of measurements were taken from the same sample locations in each of the structures. Beta scans, total alpha-beta surface activity (fixed-point) measurements, and removable surface activity smears were performed in each structure. The measurements were taken at locations considered the most likely to be contaminated, such as entranceways, drains, and high traffic areas. Beta scans were performed at approximately 1 to 2 inches per second at approximately one quarter inch from the surface using Ludlum Model 2360 coupled with a Ludlum 43-89 zinc sulfide (ZnS) scintillator. Fixed point measurements were made with 60 second static counts using a 43-89 ZnS plastic scintillator. Removable activity was determined by smearing an area of approximately 100 cm^2 and then measuring the alpha and beta activity on the smear.

The established structures screening levels for total gross alpha and beta activity were selected from Table 1, *Surface and Volume Radioactivity Standards for Clearance* [American National Standards Institute (ANSI), 1999]. The screening levels for gross alpha and beta removable activity have been set at 10 percent of the limit total for total alpha and beta activity, respectively. The screening levels used for this screening survey are listed in Table 3.2.

Table 3.2 Screening Levels

Type of Radiation	Total Contamination $dpm/100cm^2$	Removable Contamination $dpm/100cm^2$	Investigation Level for Scanning
Gross Alpha	600	60	Not applicable
Gross Beta	6000	600	4,800

4.0 SAMPLE AND WASTE DISPOSITION

Samples were surveyed, tracked by a chain of custody, packaged and sealed in strong tight containers and ground shipped from IAAAP to the USACE-validated FUSRAP Radioanalytical Laboratory located in Berkeley, Missouri. All sample containers were verified free of loose contamination and the dose rate on the outside of the shipping container was verified as being less than 0.5 millirem per hour (mrem/hr). The quality control (QC) split samples were transported by courier from the FUSRAP Radioanalytical Laboratory by Severn Trent Laboratories for analysis in their Earth City, Missouri laboratory.

There was a limited amount of waste generated as a result of this survey. The waste generated consisted of personal protective equipment (PPE) (surgeon and cotton gloves) and swipes. The PPE was surveyed for unrestricted release and placed in “clean” trash for disposal. Sampling activities at the cap extension area in the IDA resulted in the generation of Cs-137 contaminated investigation derived waste (IDW). This IDW was transferred to the DOD Executive Agent for Low Level Radioactive Waste at the Rock Island Arsenal for disposal at a licensed facility.

5.0 SURVEY RESULTS/ANALYTICAL DATA

5.1 REFERENCE AREA

As described in the *Iowa Army Ammunition Plant Scoping Survey Plan for Firing Sites 6 and 12* (USACE, 2001b), the reference area used to determine background soil uranium levels at the site. The reference area was located northeast of IAAAP Gate 4 in the field behind and southwest of Casey's General Store, as shown on Figure 5-0. Soil samples were taken from seven locations within the reference area. In addition, one duplicate sample and one split sample were taken from location IAAP25028. The soil sample locations were randomly generated and distributed across the reference area. The reference soil sample alpha spectroscopy analysis results for the uranium isotopes are shown in Table 5.1.

Table 5.1 Reference Area Soil Sample Analytical Results

Reference Area Data Summary			
Parameters	**U-234 (pCi/g)**	**U-235 (pCi/g)**	**U-238 (pCi/g)**
Mean	1.19	0.04	1.36
Median	1.35	0.03	1.42
Standard Deviation	0.29	0.05	0.26
Maximum	1.50	0.13	1.73
No. Samples	9	9	9
Reference Area Data			
Sample ID	**U-234 (pCi/g)**	**U-235 (pCi/g)**	**U-238 (pCi/g)**
IAAP25025	0.96	0.04	1.62
IAAP25026	1.40	0.00	1.73
IAAP25027	1.35	0.11	1.50
IAAP25028	1.35	0.00	1.27
IAAP25028-1[a]	1.15	0.03	1.28
IAAP25028-2[b]	0.69	0.06	1.06
IAAP25029	0.84	0.02	0.91
IAAP25030	1.46	0.03	1.42
IAAP25031	1.50	0.13	1.49

a) Field duplicate
b) Field split

5.2 EXPLOSIVE DISPOSAL AREA

The EDA was defined for this study as the North Burn Pads Landfill, the North Burn Pads, the East Burn Pads, the West Burn Pads Area, and the Area South of the West Burn Pads Area. Most of the area was densely vegetated during the walkover and sampling.

5.2.1 Gamma Walkover Survey

The majority of the gamma walkover surveys of the EDA were performed on August 17 and 18, 2004. While portions of the entire area received some coverage in accordance with the plan, the focus of the walkovers was on the following areas:

- The corridor of the creek that bisects the EDA
- Drainages to the creek that bisects the EDA
- The perimeter of the former East Burn Pads
- Area between the south road and the south perimeter fence of the East Burn Pads
- West Burn Pads Area
- North Burn Pads
- North Burn Pads Landfill

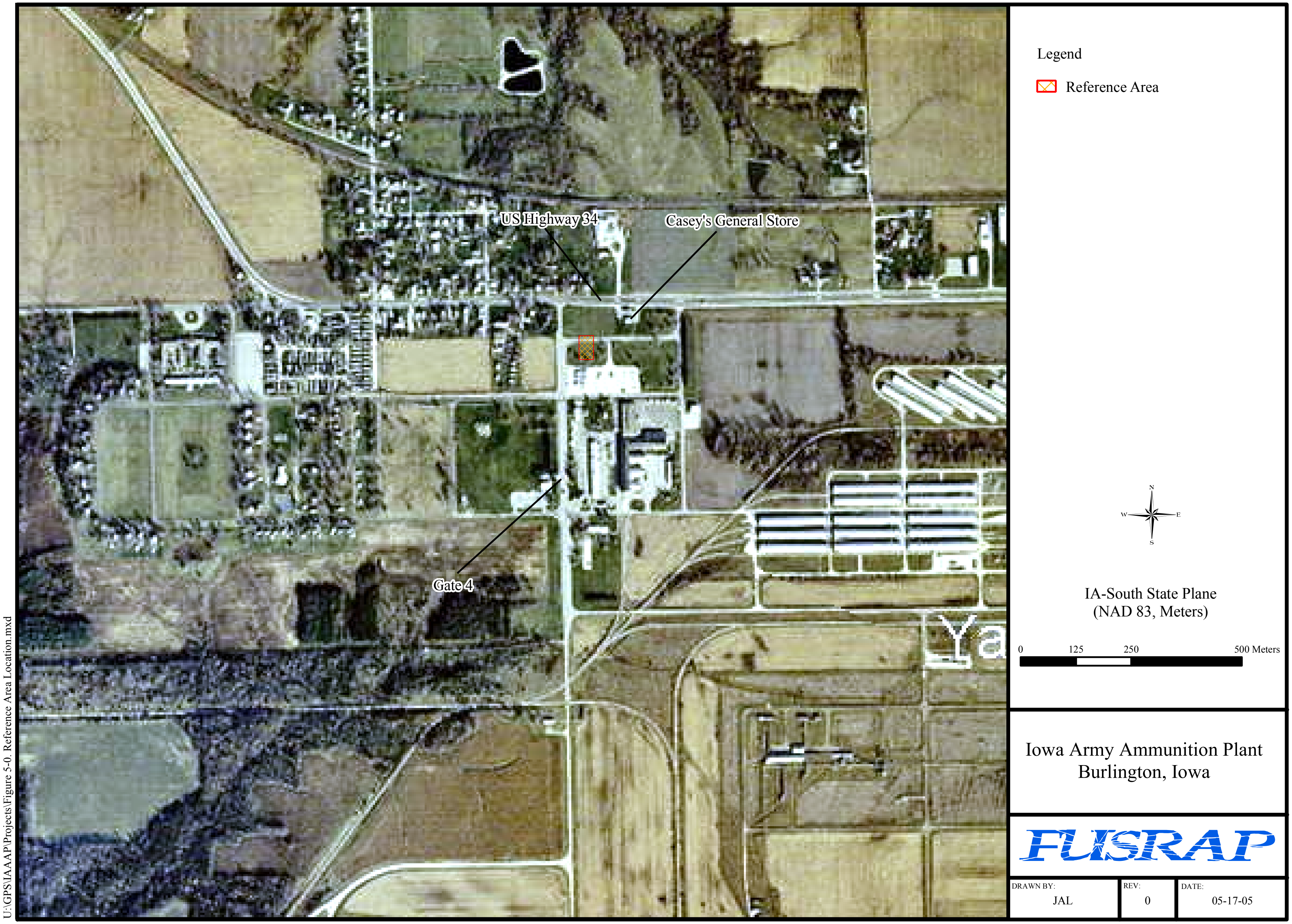

Figure 5-0. Reference Area Location

The East Burn Pads included a twelve-acre lot enclosed by a fence as well as areas to the north and southwest. The enclosed area and area north of the fence were relatively flat and covered with dense vegetation. The southwest portion of the East Burn Pads slopes to the southwest, towards the creek that bisects the EDA. Background gamma radiation levels in the East Burn Pad area generally ranged from approximately 11,000 cpm to 13,000 cpm in the fenced section and from approximately 13,000 cpm to 15,000 cpm in the area north of the fence.

The West Burn Pads Area was heavily vegetated but included two areas devoid of vegetation. This area sloped to the north towards the drainage feature that divides the West Burn Pads Area from the North Burn Pads Landfill, and to the east towards the main creek. Background radiation levels were generally between 12,000 cpm and 14,000 cpm.

The North Burn Pads and North Burn Pads Landfill sloped southward towards the drainage feature and were also heavily covered with herbaceous vegetation interspersed with trees. Gamma walkover surveys were conducted in this area with the exception of the immediate area of the CWP. Background radiation levels across the North Burn Pads and North Burn Pads Landfill, including areas immediately adjacent to the CWP, generally ranged between approximately 12,000 cpm to 14,000 cpm.

Because of concerns with unexploded ordnance (UXO), the walkover for the area south of the West Burn Pads Area was delayed until August 24, 2004 when a UXO expert from the USACE-Rock Island District was present to clear the area for walkovers and sampling. This area was heavily vegetated and sloped primarily to the east towards the main EDA drainage feature. Included in the gamma walkover survey of this portion were the areas around the bunkers along the south access road. Background radiation levels generally ranged between 10,000 cpm and 12,000 cpm.

Gamma walkover results for the EDA are presented in Figure 5-1. As described in Section 3.1, areas appearing to exhibit gamma radiation counts at rates significantly greater than background levels were investigated further to determine if the increase in count rate at the location was reproducible. Three initial anomalies were detected within the EDA and are also shown on Figure 5-1. The additional investigation (concentrated gamma walkover surveys) could not reproduce the initial readings and revealed no elevated readings; therefore, no biased samples were obtained from the EDA.

5.2.2 Soil Sampling

Twenty-four soil samples were collected from the surface interval (0 inches to 6 inches) from predetermined random locations as indicated in the survey plan (USACE, 2004a). The majority of the soil samples were collected on August 17, 18, and 24, 2004. No biased samples were collected in the EDA because no areas of reproducible elevated gamma radioactivity were identified.

Split and duplicate samples were collected at location IAAP84240. The soil throughout the EDA was primarily a brown silty clay/topsoil. Sample locations are presented on Figure 5-1.

Sample analytical results are shown in Table 5.2.2. Soil samples from the EDA exhibited uranium levels approximately equal to background levels. No sample had DU in excess of 56 pCi/g.

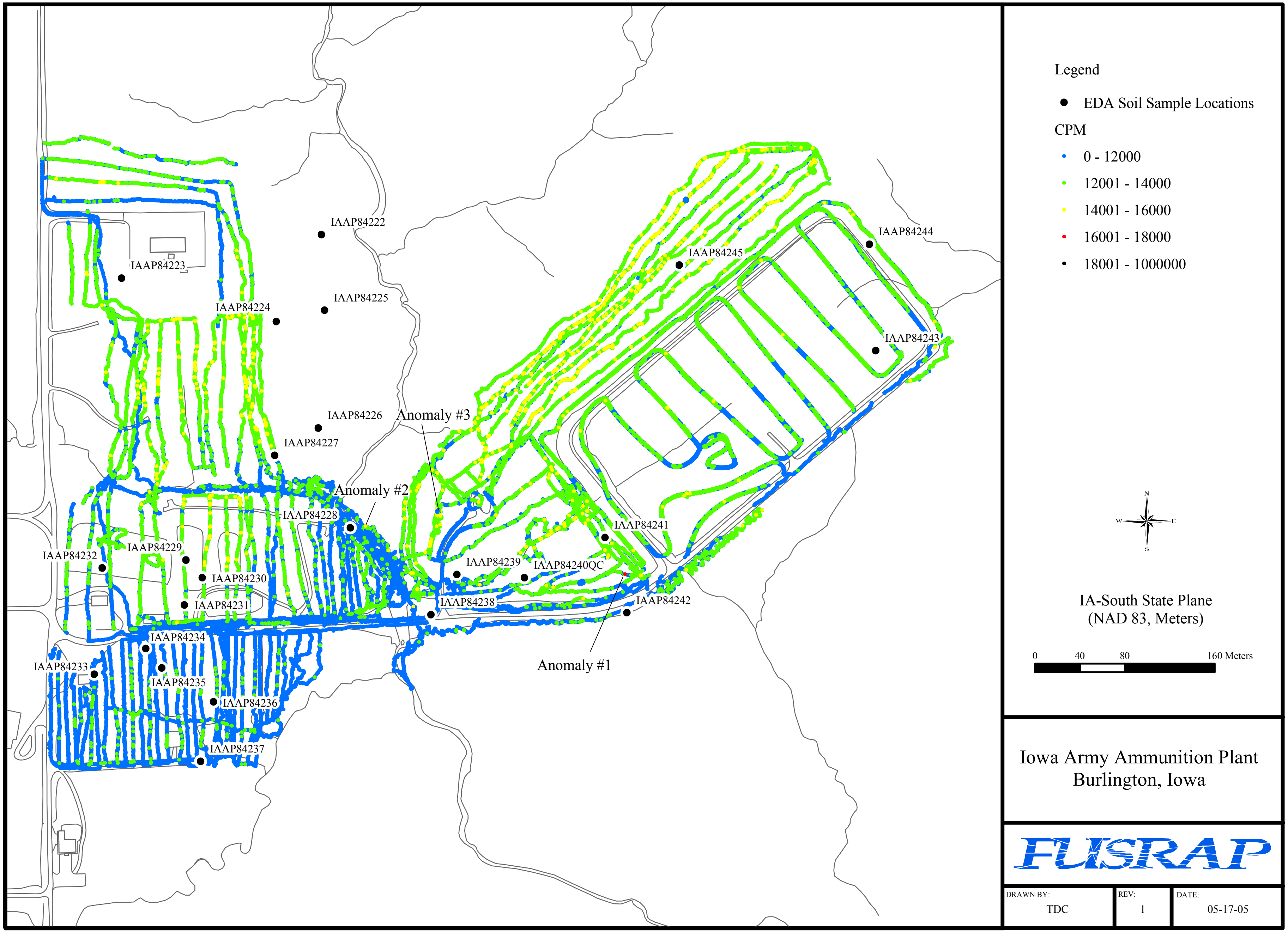

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Figure 5-1. EDA Gamma Walkover Survey Data and Soil Sample Locations

Table 5.2.2 Explosive Disposal Area Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84222	Random	0.97	0.00	1.06
IAAP84223	Random	0.73	0.13	1.00
IAAP84224	Random	1.71	0.00	0.98
IAAP84225	Random	1.63	0.14	1.80
IAAP84226	Random	1.01	0.12	0.86
IAAP84227	Random	2.03	1.02	1.54
IAAP84228	Random	1.04	0.00	0.46
IAAP84229	Random	0.96	0.08	0.71
IAAP84230	Random	1.07	0.00	1.01
IAAP84231	Random	0.83	0.20	0.79
IAAP84232	Random	1.86	0.00	0.88
IAAP84233	Random	0.75	0.00	0.57
IAAP84234	Random	1.01	0.05	1.56
IAAP84235	Random	1.37	0.08	1.22
IAAP84236	Random	1.22	0.00	1.12
IAAP84237	Random	0.60	0.07	0.78
IAAP84238	Random	0.44	0.00	0.81
IAAP84239	Random	0.55	0.00	0.86
IAAP84240	Random	0.79	0.00	0.64
IAAP84241	Random	0.95	0.00	0.78
IAAP84242	Random	0.57	0.03	0.48
IAAP84243	Random	0.99	0.06	1.05
IAAP84244	Random	1.12	0.00	0.61
IAAP84245	Random	1.33	0.00	1.27

5.2.3 Building Surveys

Building surveys were performed on bunkers BG-2, BG-3, BG-4, and BG-5 and building BG-1 on August 24, 2004. Surveys focused on areas that would likely be contaminated. Each building surveyed had a minimum of three locations scanned, alpha-beta fixed point measurements taken, and smears collected. Survey results are presented in Table 5.2.3.

According to the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE, 2004a), since the beta scan MDA (721 dpm/100 cm^2) was well below the structure screening level (6,000 dpm/100 cm^2), a minimum of two fixed-point alpha/beta and loose surface contamination measurements is appropriate in each building regardless of the results of the scan for quantitative purposes. The number of points measured was consistent with the size of the buildings. Three fixed point measurements and smears were collected in each bunker. In BG-1, a two story brick building, ten fixed point measurement locations and smears were collected. The other buildings were bunkers. BG-3 was larger than other bunkers in the EDA. All scan results were less than the investigation level. All alpha and beta fixed point readings were less than the screening levels. Survey results are presented in Attachment C. It should be noted that one fixed point location in BG-5 identified contamination near the screening level. Additional scanning was conducted near this point and throughout the bunker. A total of three fixed point measurements were taken. All additional surveys conducted were at or near background values, well below the screening values.

Table 5.2.3 Explosive Disposal Area Building Survey Results

Sample ID	Sample Location	Alpha (Removable) dpm/100cm^2	Beta (Removable) dpm/100cm^2	Alpha (Fixed) dpm/100cm^2	Beta (Fixed) dpm/100cm^2
1	BG-1	<60	<600	163	<MDC
2	BG-1	<60	<600	122	<MDC
3	BG-1	<60	<600	<MDC	1310
4	BG-1	<60	<600	<MDC	821
5	BG-1	<60	<600	163	<MDC
6	BG-1	<60	<600	<MDC	960
7	BG-1	<60	<600	<MDC	<MDC
8	BG-1	<60	<600	<MDC	<MDC
9	BG-1	<60	<600	<MDC	<MDC
10	BG-1	<60	<600	<MDC	585
1	EDA Bunker (BG-2)	<60	<600	<MDC	434
2	EDA Bunker (BG-2)	<60	<600	<MDC	<MDC
3	EDA Bunker (BG-2)	<60	<600	163	<MDC
1	BG-3	<60	<600	<MDC	490
2	BG-3	<60	<600	<MDC	<MDC
3	BG-3	<60	<600	<MDC	<MDC
1	BG-4	<60	<600	<MDC	<MDC
2	BG-4	<60	<600	<MDC	<MDC
3	BG-4	<60	<600	<MDC	<MDC
1	BG-5	<60	<600	533	739
2	BG-5	<60	<600	<MDC	<MDC
3	BG-5	<60	<600	<MDC	<MDC

5.3 INERT DISPOSAL AREA

The IDA covers approximately 20 acres that includes a trench-and-fill landfill that operated from 1941 to 1992, a burning ground, a metal salvage operation, a sludge lagoon closed in 1984, a wastewater sludge drying bed, and an earthen holding area formerly used to store sludge. Trench 6, Trench 7, and the cap extension area (random fill) were the areas surveyed and sampled as a part of this survey effort.

5.3.1 Gamma Walkover Survey

Gamma walkover surveys were performed on Trenches 6 and 7 of the IDA on August 23, 2004. The cap extension area was surveyed on August 26, 2004. The gamma walkover survey of Trench 7 and the cap extension area revealed areas of apparent elevated radioactivity that were further investigated and subsequently sampled as described below. Gamma walkover results are shown in Figure 5-2.

Gamma walkover surveys at the IDA began at Trench 7, located in the northwest corner of the IDA. Visible within the trench were fill materials including soil, rubble, and metal debris. Liner material was exposed at the surface across much of the trench area, particularly in the southern and western portions. The depth of the fill materials appeared greater in the north end of the Figure 5.2 trench than the south end where more of the trench side slopes were visible. Some vegetation was present across the soil-covered portions. The southern portion of the trench served as a storm-water collection sump. Background radiation levels were in the 12,000 cpm to 14,000 cpm range within the trench. Higher levels were observed on the western slope of the trench. This slope consisted primarily of exposed liner material. It is likely that these increased levels can be attributed to the substantial change in geometry in that portion of the survey area.

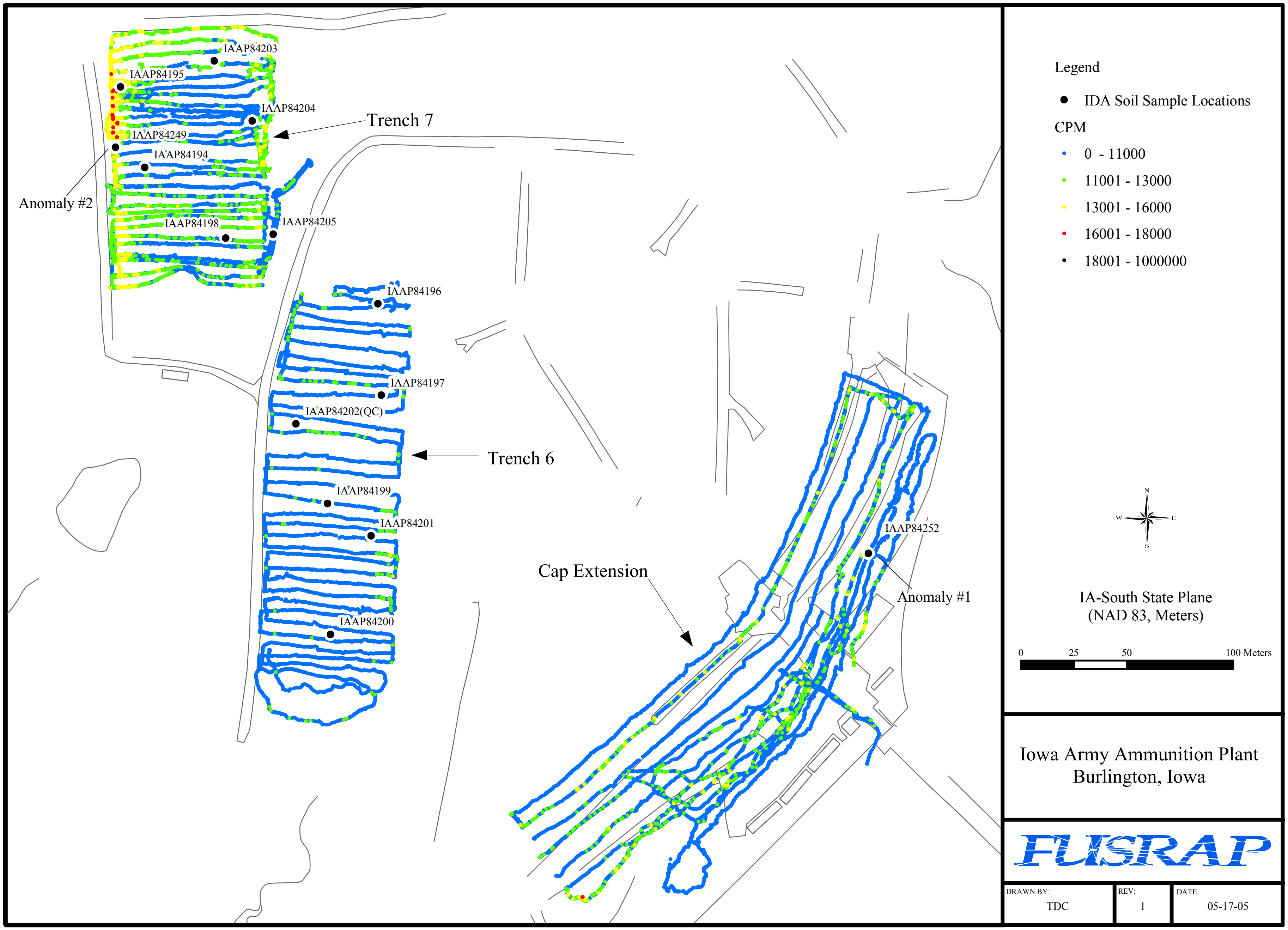

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Figure 5-2. IDA Gamma Walkover Survey Data and Soil Sample Locations

Biased sample IAAP84249 was obtained from this slope on the day following the initial survey to investigate the increased levels. Additional gamma levels were obtained using a NaI 2X2 to identify the area of highest sustained counts or gamma radiation. The area of highest gamma levels at the time of the sampling was the area sampled and is considered representative of the larger are of elevated counts. No other significant anomalies were identified in Trench 7. Soil sample analytical results are presented in Section 5.3.2.

Gamma walkover surveys continued in Trench 6, located just southeast of Trench 7. The floor of this trench was primarily soil, debris, and waste materials. Conditions similar to Trench 7 were observed; the depth of the deposited material within the trench was greater in the north end than the south end. The southern portion of the trench served as a storm-water collection sump. The eastern slope was covered with exposed liner material. The materials within Trench 6 exhibited gamma radiation background levels of 9,000 cpm to 11,000 cpm with no significant anomalies.

On August 26, 2004, a gamma walkover survey was performed on the cap extension area portion of the IDA. The cap extension area is an above-grade feature (stockpile) located in the eastern portion of the IDA, just inside the main entrance gate. The surface of the cap extension area was varied and included bare soil, areas of thick vegetation, and some rubble. The gamma walkover survey of the cap extension area showed that gamma radiation levels generally ranged between 12,000 cpm to 14,000 cpm. One area indicating gamma radiation of approximately 100,000 cpm was identified on top of the pile, approximately 80 m south of the cap's northern limits. A biased soil sample, IAAP84252, was obtained from that location to investigate the elevated activity. Additional discussion on soil sampling and the associated analytical results is presented in Section 5.3.2.

5.3.2 Soil Sampling

Twelve randomly-located and two biased soil samples were collected at the IDA. Many sample locations, as presented in the survey plan (USACE 2004a), did not fall within Trench 6 and Trench 7 as originally intended. It was therefore necessary for the sampling locations to be randomly redistributed within the trenches as shown on Figure 5-2. Sample depth for each randomly-located location was randomly established from each discrete 6-inch interval within the first 24 inches of the soil profile. The analytical results of the soil samples collected from the IDA are shown in Table 5.3.2.

Table 5.3.2 Inert Disposal Area Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84194	Random	1.05	0.14	1.16
IAAP84195	Random	1.53	0.00	1.38
IAAP84196	Random	1.34	0.26	1.33
IAAP84197	Random	0.98	0.00	0.97
IAAP84198	Random	1.16	0.00	1.33
IAAP84199	Random	1.39	0.22	1.33
IAAP84200	Random	2.08	0.00	3.06
IAAP84201	Random	0.72	0.00	0.56
IAAP84202	Random	1.24	0.00	1.28
IAAP84203	Random	0.97	0.00	1.45
IAAP84204	Random	0.76	0.06	0.75
IAAP84205	Random	0.65	0.00	0.9
IAAP84249	Biased	1.14	0.09	1.58
IAAP84252	Biased	0.56	0.12	0.84

In Trench 7, three samples were collected from the surface interval of 0 inches to 6 inches bgs, and one each at the 6 inches to 12 inches, 12 inches to 18 inches, and 18 inches to 24 inches intervals. The soil was described as very dark and grey/brown sandy clay. The same process was applied to samples collected in Trench 6. The soil was described as brown with sand, silt, and clay. Split and duplicate samples were also collected at location IAAP84202.

The first of the two biased samples collected in the IDA, IAAP84249, was a surface sample collected from the western berm of Trench 7 to investigate generally elevated gamma walkover readings along this berm. Uranium in this sample was at background levels.

The second biased sample, IAAP84252, was collected as the result of the gamma walkover survey on the cap extension area where a metallic object of unknown origin was located at approximately 6 inches bgs and removed. The metallic object measured approximately 1-inch by 2-inches and exhibited a beta/gamma field screen reading of approximately 33,000 cpm on a Ludlum 44-9. The soil sample (IAAP84252) was taken from the 0 to 8 inches bgs interval after the metallic object was removed. Subsequent gamma spectroscopy analysis revealed that the soil in sample IAAP84252 contained 226 pCi/g Cs-137, while the metallic object exhibited approximately 100,000 pCi/g Cs-137. Uranium in the soil sample was at background level. No uranium was detected in the metallic object. Locations of samples taken from the IDA areas are shown on Figure 5-2. The highest U-238 concentration was 3.06 pCi/g, from random sample IAAP84200, which is well below the 56 pCi/g soil screening level concentration for DU.

Due to batch processing with IAAP85252 and the potential for cross-contamination, the reported Cs-137 result for IAAP84201 is from the initial gamma analysis, as noted in Attachment B.

5.4 DEMOLITION AREA/DEACTIVATION FURNACE

The DA/DF area is approximately a 10-acre parcel on the southwestern portion of the IAAAP that was used for open detonation of ammunition items that required immediate disposal. The Deactivation Furnace includes a feed area and retort system, an adjoining air pollution control system, and an exhaust stack. The physical boundaries for this survey were limited to the open field to the east and the tree line on the other three sides.

5.4.1 Gamma Walkover Survey

Gamma walkover surveys were conducted in the DA/DF portion of the IAAAP on August 24, 25, and 26, 2004. There were four investigation points identified during the initial gamma walkover. These four locations are identified in the Figure 5-3.

Initial gamma walkover surveys focused on the area immediately surrounding the Deactivation Furnace. Soil in this vicinity was heavily vegetated at the time of the survey except for those portions immediately south and west of the Deactivation Furnace where gravel drives and former parking areas exist. Soil in this vicinity exhibited gamma radiation background levels of approximately 9,000 cpm to 11,000 cpm with no anomalies.

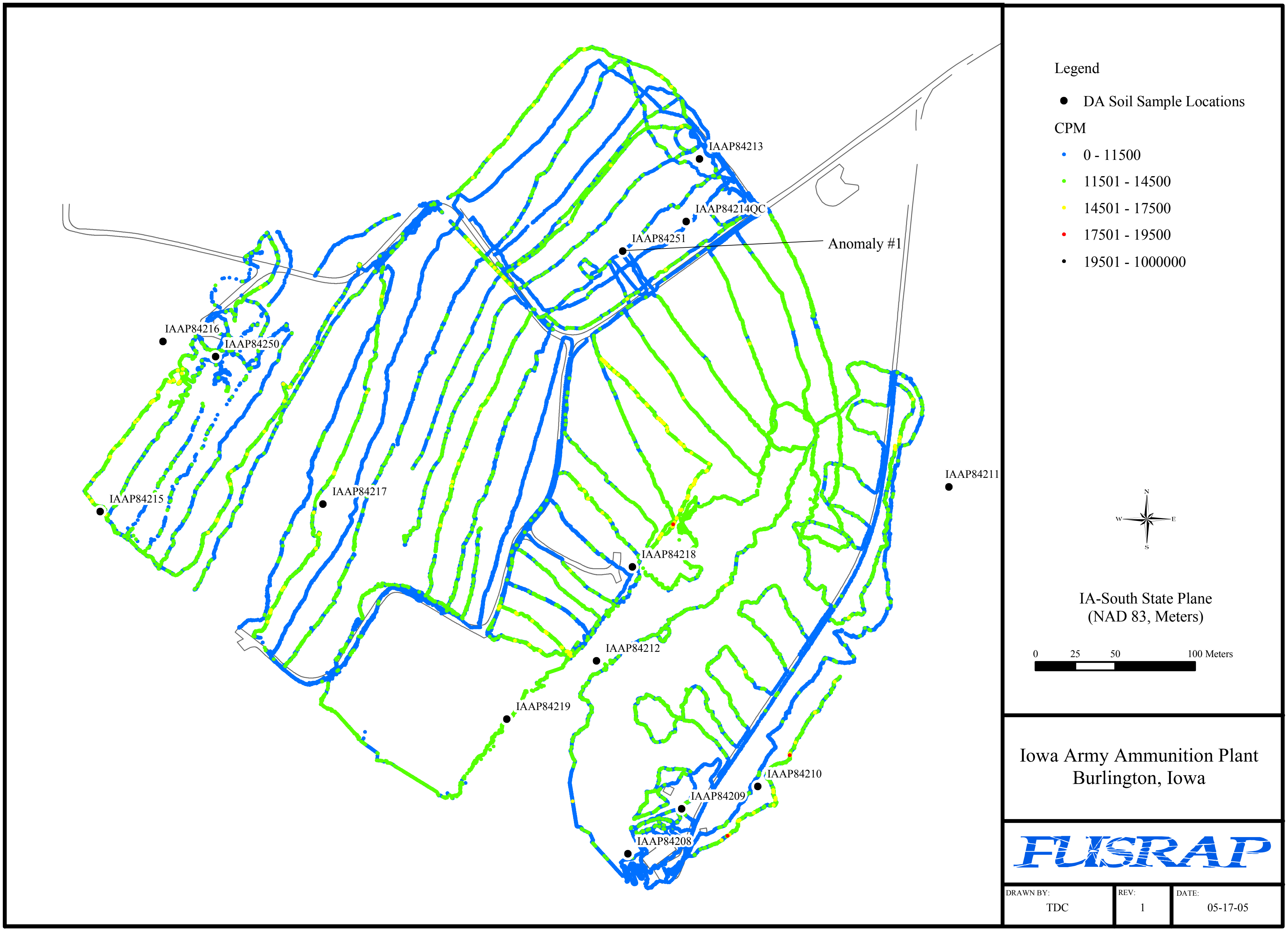

Figure 5-3. DA/DF Gamma Walkover Survey Data and Soil Sample Locations

Gamma walkover surveys were also conducted in the open areas on both the east and west side of the Deactivation Furnace entrance road. The area west of the entrance road was heavily covered with herbaceous vegetation with some pockets of small trees. The area generally sloped westward, toward the wooded drainage that separates this area from the Demolition Area. The area east of the access road was also heavily covered with herbaceous vegetation and generally sloped eastward towards an adjacent drainage. Soil in this vicinity exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm with no anomalies.

Gamma walkover surveys were also conducted in and along the surface-water drainage that separates the Demolition Area from the Deactivation Furnace area. This drainage was heavily wooded and contained significant understory vegetation. The substrate ranged from loose topsoil to rocky outcroppings. Depth of the drainage, as compared to the surrounding topography, increased towards the southwest. Substrate in this drainage exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm with no anomalies.

The area between the main surface-water drainage way and the entrance road to the Demolition Area received a gamma walkover survey. This area was heavily covered with herbaceous vegetation with occasional groups of trees. This area generally sloped to the southeast, towards the main surface-water drainage. Soil in this vicinity exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm with no anomalies.

Gamma walkover surveys were conducted in the area to the north of the Demolition Area entrance road near bunker 900-189-1. This portion of the Demolition Area is relatively flat and contains some areas of thick vegetation, while other areas, particularly near the demolition pad, contain much less vegetation. Surveys in this area were focused primarily on the demolition pad area and the bunkers in the eastern portion. Soil in this vicinity exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm. An area that appeared to exhibit gamma radiation levels that were slightly above the surrounding area was identified just north of the main demolition pad. Biased sample IAAP84251 was taken at that location to investigate. Soil sample analytical results are discussed in Section 5.4.2. No anomalies were identified in other portions of this area.

A gamma walkover was also conducted over the large area of land located west of the "Y" in the Demolition Area entrance road. This area was heavily covered with herbaceous vegetation and contained pockets of medium sized trees. In the northwestern portion of this area there is a highly eroded area that appears to drain surface-water from this watershed. Because this area is an obvious topographical low point, and therefore a possible area for deposition of potentially radioactive demolition materials, gamma walkover surveys focused on this portion of the area. Soil across the flat portion of this area as well as the eroded section exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm with no anomalies.

5.4.2 Soil Sampling

In accordance with the survey plan (USACE, 2004a), twelve randomly-located samples were collected in the DA/DF area, from the surface interval (0 inches to 6 inches). The planned locations of three sampling points (IAAP84211, IAAP84215, and IAAP84216) fell in areas of heavy tree and brush cover just outside the DA/DF study area. Therefore, these locations were moved, no more than 18 meters, in order to be located back into the study area. The soil was generally dark brown topsoil with some samples containing silt and clay. The analytical results of the soil samples collected from the DA/DF are shown in Table 5.4.2.

Table 5.4.2 Demolition Area/Deactivation Furnace Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84208	Random	0.97	0.14	1.10
IAAP84209	Random	0.85	0.29	1.29
IAAP84210	Random	0.93	0.00	1.18
IAAP84211	Random	1.57	0.19	1.23
IAAP84212	Random	1.20	0.11	1.30
IAAP84213	Random	1.27	0.07	1.16
IAAP84214	Random	1.08	0.13	1.14
IAAP84215	Random	0.68	0.05	0.87
IAAP84216	Random	0.96	0.00	0.74
IAAP84217	Random	0.72	0.07	1.15
IAAP84218	Random	0.77	0.00	0.59
IAAP84219	Random	1.19	0.06	1.37
IAAP84250	Biased	0.84	0.04	0.48
IAAP84251	Biased	0.78	0.18	0.86

The potential presence of subsurface UXO was a concern in this area. Therefore, sampling locations were investigated for subsurface objects by an UXO specialist prior to intrusive sampling. The UXO expert arrived on the site on August 24, 2004.

Two biased samples were collected from this area. One biased sample, IAAP84250, was collected from the surface interval at the bottom of the eroded zone in the northwestern portion of the Demolition Area. This area is an obvious low point within the surrounding topography and therefore has the potential to be an accumulation point for sediments from that portion of the site. The other biased sample, IAAP84251, was collected from a burn pad near the bunkers in the northern portion of the area. Initial gamma walkover surveys indicated a slight increase in radioactivity at the location of this soil sample. Sample locations are shown on Figure 5-3. Soil sample analytical results for the DA/DF from both biased and random sampling locations were well below the 56 pCi/g soil screening level concentration for DU.

5.4.3 Building Surveys

Building surveys were performed on Bunker 900-189-1 in the Demolition Area and several buildings and two concrete pads in the Deactivation Furnace area on August 25, 2004. Surveys focused on areas that would likely be contaminated. Survey results are presented in Attachment C.

Three alpha-beta fixed point measurements were collected on the interior of Bunker 900-189-1. The entrances and walkway between the two entrances were surveyed. At each fixed point measurement location a smear was also taken to assess removable contamination. Bunker 900-189-1 results were below the screening levels. Two bunkers near Bunker 900-189-1 were not surveyed, due to either safety concerns or the fact that they were full of materials and therefore not accessible. Based on historical uses and the findings of this survey, as well the findings of bunker surveys at the EDA, additional surveys of DA/DF bunkers are not necessary.

The Deactivation Furnace consisted of several structures located on two concrete pads. The Deactivation Furnace buildings are not in use; however one is used for storage. Some structures were not accessed due to safety concerns. Areas that were accessible for surveying included the concrete pads and a room where explosives were loaded into the furnace. The concrete pads at this facility exhibited alpha results over the 600 dpm/100cm^2 screening level.

Twenty alpha-beta fixed point measurements were taken at the deactivation furnace, and smears were collected to assess removable contamination. The results of the surveys are presented in

Table 5.4.3. Due to the noted increase in alpha counts, alpha scanning was used during the investigation of the concrete pads at the Deactivation Furnace. According to the IAAAP radiological survey plan (USACE, 2004a) only two points are needed per structure, however, more readings were taken to determine the extent of the elevated alpha activity on the concrete pads. The area having the highest alpha reading was located on the small concrete pad. Survey personnel covered this small area with plastic sheeting for 24 hours after which another reading was made to rule out radon as a possible cause for the elevated readings. The reading before the plastic was put in place was 2935 dpm/cm^2 and 24 hours later when the plastic was removed it was 2038 dpm/cm^2. Survey personnel noted the presence of dark-colored stains intermittently distributed on the small concrete pad.

Table 5.4.3 Demolition Area/Deactivation Furnace Building Survey Results

Sample ID	Sample Location	Alpha (Removable) dpm/100cm^2	Beta (Removable) dpm/100cm^2	Alpha (Fixed) dpm/100cm^2	Beta (Fixed) dpm/100cm^2
1	Deactivation Furnace	<60	<600	224	531
2	Deactivation Furnace	<60	<600	1427	1624
3	Deactivation Furnace	<60	<600	1182	1246
4	Deactivation Furnace	<60	<600	1060	1086
5	Deactivation Furnace	<60	<600	1936	1352
6	Deactivation Furnace	<60	<600	2935	2208
7	Deactivation Furnace	<60	<600	1957	1476
8	Deactivation Furnace	<60	<600	387	768
9	Deactivation Furnace	<60	<600	265	892
10	Deactivation Furnace	<60	<600	795	886
11	Deactivation Furnace	<60	<600	<MDC	<MDC
12	Deactivation Furnace	<60	<600	<MDC	490
13	Deactivation Furnace	<60	<600	<MDC	<MDC
14	Deactivation Furnace	<60	<600	224	496
15	Deactivation Furnace	<60	<600	734	744
16	Deactivation Furnace	<60	<600	326	472
17	Deactivation Furnace	<60	<600	122	531
18	Deactivation Furnace	<60	<600	387	638
19	Deactivation Furnace	<60	<600	571	496
20	Deactivation Furnace	<60	<600	632	880
1	DEMO 900-189-1	<60	<600	<MDC	<MDC
2	DEMO 900-189-1	<60	<600	<MDC	<MDC
3	DEMO 900-189-1	<60	<600	<MDC	<MDC

5.5 LINE 1 FORMER WASTEWATER IMPOUNDMENT

For purposes of this survey, the L1FWWI includes the impoundment from dam to dam and covers approximately 7.5 acres. The survey area also included the area extending approximately 100 meters north of the north dam, to the Line 1 perimeter fence to the east, and south to the perimeter road located south of the south dam. The survey boundary area extends west to the perimeter road that runs north and south on top of the berm. It was noted that the Line 1 impoundment was located downhill from Line 1 and the two areas are separated by a chain-link fence. Based on the topography of the area east of the impoundment basin, it appeared that the surface-water from a portion of the Line 1 area drained toward and eventually into the waste-water impoundment basin. The impoundment floor was under water at the time of the visit and the visible surrounding soil was covered with grass.

5.5.1 Gamma Walkover Survey

Gamma walkover surveys of the L1FWWI occurred on August 16 and 17, 2004. The focus of the surveys was along the circumference of the impoundment basin, an island surrounded by water, the drainage ways exiting from the west side of Line 1 leading to the impoundment, and the areas north of the north dam and south of the south dam. The heavily vegetated sloped area northeast of the impoundment and the grassy strip adjacent to the Line 1 fence received a less dense coverage. Gamma walkover results are shown in Figure 5-4.

Because of the relatively low water levels and forecasted rain, initial gamma walkover survey efforts focused on the area in the immediate vicinity of the impoundment. Most of the area immediately adjacent to the impounded water was steep-sloped and heavily covered with vegetation. An “island” measuring approximately 40 m by 20 m was accessible in the impoundment bottom and was surveyed. Soil immediately adjacent to the impounded water and soil on the exposed “island” exhibited background radiation levels between approximately 9,000 cpm and 11,000 cpm and showed no anomalies.

Gamma walkover surveys continued in the area between the impoundment basin and the west perimeter fence of Line 1. This area was heavily vegetated and sloped from Line 1 towards the impoundment basin. Several areas near the Line 1 perimeter fence exhibited gamma count rates at above-background levels, however these results were not sustained and were not reproduced upon further investigation. In addition, increased counts in some areas can be attributed to significant changes in ground surface geometry, i.e., holes into which the survey meter was placed. Soil on the sloped area between the impoundment basin and the west perimeter fence generally exhibited background gamma radiation levels between approximately 11,000 cpm and 13,000 cpm.

Gamma walkover surveys were conducted along the drainage channel north of the north dam of the impoundment. The area adjacent to the stream channel extending approximately 100 m north of the dam was low-lying and heavily covered with herbaceous vegetation. Background gamma radiation levels in this area generally ranged between approximately 9,000 cpm to 11,000 cpm with no anomalies.

Gamma walkover surveys were also conducted along the drainage channel south of the south dam of the impoundment. These surveys covered areas along the drainage channel from the south dam road to near the culvert that delivers water beneath the main road. The area along this drainage channel was rocky and overgrown with herbaceous vegetation and some trees. One sustained, reproducible area of elevated radioactivity was identified in this drainage immediately adjacent to a larger boulder. This small area exhibited a sustained gamma activity of approximately 15,000 cpm in an area with a background level of approximately 11,000 cpm. A biased soil sample, IAAP84248 was obtained from this location. Additional discussion and soil sample analytical results are presented in Section 5.5.2.

5.5.2 Soil Sampling

Twelve random and one biased sample were collected from the L1FWWI area on August 19, 2004. Because of water present in the impoundment, four random sample locations (IAAP84180, IAAP84187, IAAP84188, and IAAP84189) were moved approximately 3 meters from the location prescribed by the survey plan to the locations indicated on Figure 5-4. Six of the random samples were collected from 0 inches to 6 inches bgs while the other six were from Figure 5.4 the 6 inches to 12 inches bgs interval. The six random samples that were collected from the 6 inches to 12 inches interval were primarily collected in or near the basin. The collection of subsurface samples was performed in an effort to identify any potential contamination that may have been covered by the deposition of silt in the basin. At sample location IAAP84184, one split sample and one duplicate sample were also collected. The soil in the area of the impoundment was predominately brown and gray silty clay.

One biased soil sample (IAAP84248) was collected from the isolated area of elevated radioactivity identified south of the south dam. Soil sample analytical results from the L1FWWI area are presented in Table 5.5. Analytical results from soil samples obtained within the L1FWWI survey area show that DU concentrations are less than the established screening level of 56 pCi/g. The concentrations of uranium isotopes in samples from the impoundment area are similar to those of the reference area samples.

Table 5.5 Line 1 Former Wastewater Impoundment Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84180	Random	0.65	0.06	0.84
IAAP84181	Random	1.03	0.00	0.65
IAAP84182	Random	1.23	0.08	1.43
IAAP84183	Random	1.27	0.07	1.14
IAAP84184	Random	1.04	0.04	0.69
IAAP84185	Random	0.84	0.07	0.74
IAAP84186	Random	1.39	0.00	0.61
IAAP84187	Random	0.85	0.14	1.28
IAAP84188	Random	0.52	0.05	0.77
IAAP84189	Random	0.47	0.00	0.57
IAAP84190	Random	0.59	0.00	0.76
IAAP84191	Random	1.19	0.07	1.14
IAAP84248	Biased	0.97	0.07	1.14

5.6 ADDITIONAL SOIL DATA

In addition to the target analyte (depleted uranium), the collected soil samples from four investigation areas were analyzed by gamma spectroscopy for Ac-227, Cs-137, K-40, Pa-231, Ra-226, Ra-228, Th-228, Th-230, and Th-232. Available reference area values are presented in Table 5.6.1.

Of the 60 soil samples collected from the four investigation areas, only one sample exhibited results above background or the detection limit for any of the radionuclides analyzed. This soil sample, IAAP84252, was associated with the Cs-137-containing metal object discussed in Section 5.3.2 and indicated a Cs-137 concentration of 226 pCi/g. The mean reference area value for Cs-137 is 0.47 pCi/g. Summary statistics for the additional nuclides are presented below in tables 5.6.2 through 5.6.5. Individual values for these radionuclides are presented in Appendix B.

Table 5.6.1 Reference Area Soil Sample Analytical Results for Additional Nuclides

Reference Area Data Summary					
Parameter	**Cs-137**	**K-40**	**Ra-228**	**Th-228**	**Th-232**
Mean	0.47	13.35	0.98	0.98	0.98
Median	0.43	14.03	1.09	1.09	1.09
Standard Deviation	0.11	2.27	0.21	0.21	0.21
Range	0.32	6.86	0.55	0.55	0.55
Maximum	0.69	15.70	1.14	1.14	1.14
Number (n)	7.00	7.00	7.00	7.00	7.00

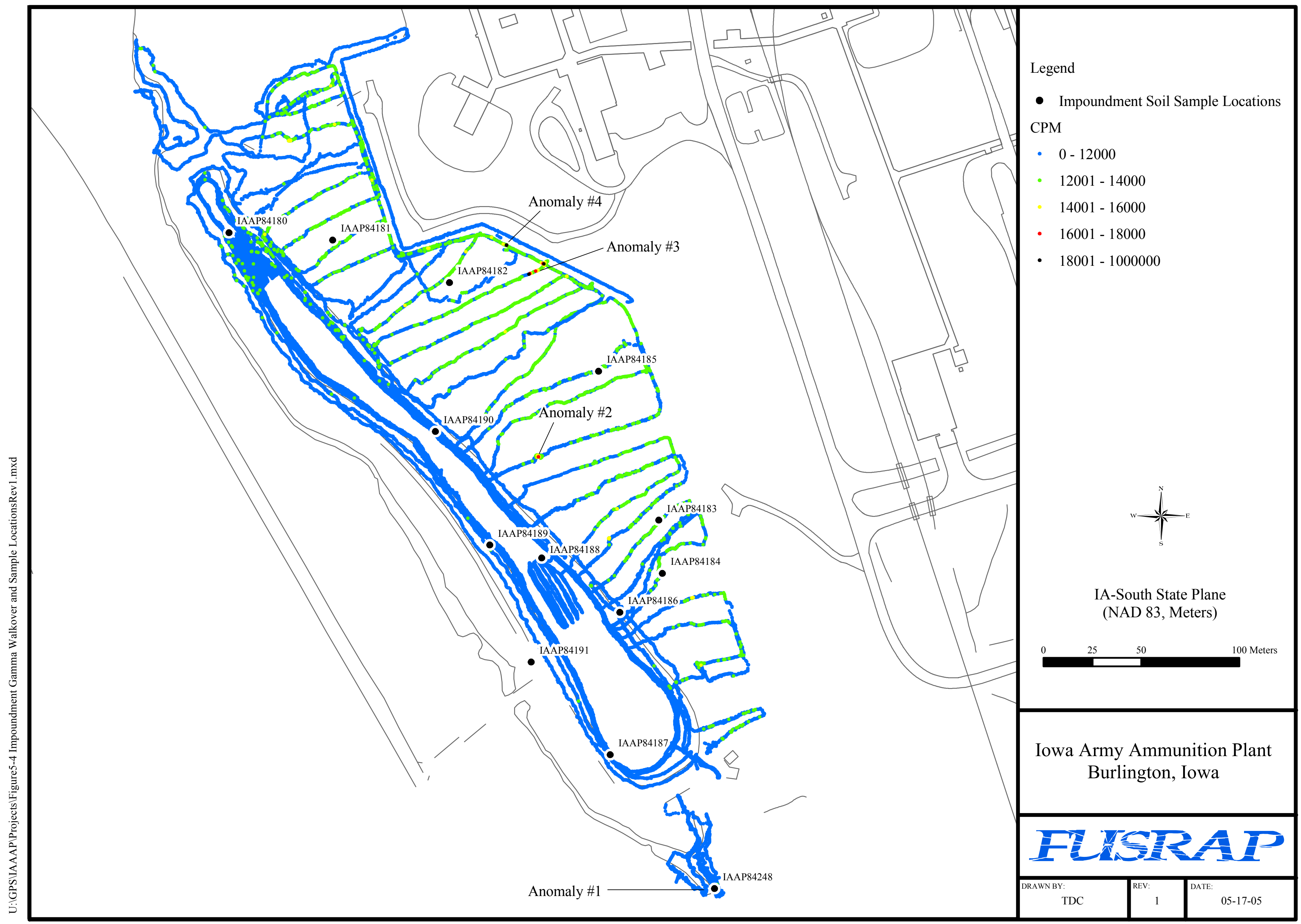

Figure 5-4. L1FWWI Gamma Walkover Survery Data and Soil Sample Locations

Table 5.6.1 Reference Area Soil Sample Analytical Results for Additional Nuclides (Cont'd)

Reference Area Data					
Parameter	**Cs-137**	**K-40**	**Ra-228**	**Th-228**	**Th-232**
IAAP25025	0.43	14.52	0.95	0.95	0.95
IAAP25026	0.38	13.99	1.13	1.13	1.13
IAAP25027	0.37	14.03	1.09	1.09	1.09
IAAP25028	0.53	12.01	0.81	0.81	0.81
IAAP25029	0.69	8.84	0.59	0.59	0.59
IAAP25030	0.42	14.39	1.12	1.12	1.12
IAAP25031	0.44	15.70	1.14	1.14	1.14

Table 5.6.2 Additional Soil Data from the EDA

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean	0.02	0.32	0.15	13.16	1.09	0.84	0.84	1.39	0.84
Median	0.00	0.34	0.17	13.38	1.06	0.90	0.90	0.76	0.90
Standard Deviation	0.03	0.20	0.14	3.33	0.19	0.23	0.23	1.84	0.23
Range	0.13	0.62	0.44	13.00	0.81	0.93	0.93	7.50	0.93
Maximum	0.13	0.64	0.44	18.56	1.53	1.21	1.21	7.50	1.21
No. Samples (n)	24	24	24	24	24	24	24	24	24

Table 5.6.3 Additional Soil Data from the IDA

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean	0.02	16.27	0.14	12.31	1.12	0.84	0.84	0.58	0.84
Median	0.00	0.10	0.12	12.39	1.12	0.86	0.86	0.00	0.86
Standard Deviation	0.05	60.42	0.15	2.47	0.19	0.21	0.21	0.95	0.21
Range	0.18	226.20	0.46	8.21	0.56	0.78	0.78	3.14	0.78
Maximum	0.18	226.20	0.46	16.43	1.46	1.31	1.31	3.14	1.31
No. Samples (n)	14	14	14	14	14	14	14	14	14

Table 5.6.4 Additional Soil Data from the Demolition Area / Deactivation Furnace

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean	0.05	0.21	0.13	15.16	1.18	0.98	0.98	1.29	0.98
Median	0.03	0.15	0.04	15.75	1.22	0.97	0.97	0.82	0.97
Standard Deviation	0.06	0.20	0.15	2.06	0.12	0.10	0.10	1.58	0.10
Range	0.18	0.54	0.38	7.67	0.41	0.37	0.37	4.28	0.37
Maximum	0.18	0.53	0.38	17.75	1.37	1.11	1.11	4.28	1.11
No. Samples (n)	14	14	14	14	14	14	14	14	14

Table 5.6.5 Additional Soil Data from Line 1 Former Wastewater Impoundment

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean	0.01	0.14	0.18	12.87	0.95	0.86	0.86	0.85	0.86
Median	0.00	0.07	0.17	12.34	1.02	0.85	0.85	0.60	0.85
Standard Deviation	0.01	0.17	0.20	2.33	0.27	0.18	0.18	1.08	0.18
Range	0.04	0.54	0.71	7.47	0.88	0.65	0.65	3.93	0.65
Maximum	0.04	0.54	0.71	17.33	1.47	1.25	1.25	3.93	1.25
No. Samples (n)	13	13	13	13	13	13	13	13	13

6.0 CONCLUSIONS

A total of 64 out of 65 soil samples had results not significantly different than background or less than the detection limit for all analyzed parameters. Based on the results of this survey, the only investigation area where above-background radiological contamination was verified was the cap extension area of the IDA. In addition, above-screening-level results were found at the Deactivation Furnace. These two anomalies are discussed in the following paragraphs.

As described in Section 5.3.2, elevated gamma radiation levels were detected and investigated at a location on the top of the cap extension area at the IDA. It was determined that the elevated gamma radiation levels were a result of the presence of a subsurface metallic object and immediately adjacent soil. Initial screening indicated that the metallic object contained approximately 100,000 pCi/g Cs-137 while the soil immediately adjacent to the object contained approximately 226 pCi/g Cs-137. Total activity for the object and associated soil sample was later determined to be 10^7 pCi (10^{-2} millicuries) and 1.5×10^5 pCi (1.5×10^{-4} millicuries), respectively. The object was removed from the IAAAP for further investigation and the remaining soils were left in place with an additional layer of cover material. In the present configuration, the remaining soils present no significant dose or environmental hazards.

As described in Section 5.4.3, the small concrete pad at the Deactivation Furnace had several fixed alpha measurements that were greater than the screening level. The highest reading (2935 dpm/100cm^2) exceeded the structures screening level of 600 dpm/100cm^2 presented in the IAAAP Radiological Survey Plan (USACE, 2004a). The entire pad exhibited elevated alpha counts but there were no visible differences in the area with the highest reading relative to the remainder of the pad and no removable contamination was found on the pad. Radon daughter plateout was investigated and ruled out as a potential cause. Based on similar situations at other sites, as well as professional judgment, it is believed that the cause of the elevated counts on the pad are due to naturally occurring radioactive material contained within the concrete. In its current configuration the concrete poses no significant dose or environmental hazard.

Due to the lack of above-background concentrations of uranium in the soil samples and the lack of areas of DU-driven elevated gamma activity, the investigation areas are not impacted with DU contamination. In addition, with the exception of the two anomalies discussed above, the investigation areas were found to be unimpacted by the presence of other evaluated gamma emitting radionuclides. During the course of this survey no evidence was found that MED/AEC radionuclides of potential concern have impacted these areas.

7.0 ADDITIONAL ACTIONS

No further actions are necessary to evaluate any of the investigation areas for the presence of DU or other radiological parameters, with the following two exceptions, based on the results of this investigation and information obtained to date.

The Cs-137 contamination at the IDA cap extension area needs to be delineated, evaluated, and the environmental risk calculated and controlled. Possible follow-up actions may involve additional sampling and/or small scale remediation to remove any potential environmental risk associated with the presence of the Cs-137 contamination.

The elevated alpha contamination on the concrete pads of the Deactivation Furnace appears to be randomly distributed across the pads which is consistent with naturally occurring radioactive material (NORM). If future demolition work is planned in this portion of the Deactivation Furnace, disposition requirements should be determined through consultation with appropriate regulatory agencies.

8.0 References

American National Standard Institute (ANSI), 1999. *Surface and Volume Radioactivity Standards for Clearance,* ANSI/HPS N13.12.

Department of the Army, 2002. *Iowa Army Ammunition Plant Installation Action Plan.* Middletown, Iowa. October.

Department of Defense (DOD), 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),* NUREG-1575, EPA402-R-97-016, Department of Defense et al. August.

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USACE, 2004b. Letter to EPA Region VII. 3 Feb. 2004.

ATTACHMENT A

QUALITY CONTROL SUMMARY REPORT

Iowa Army Ammunition Plant
QUALITY CONTROL SUMMARY REPORT

A-1 INTRODUCTION

A-1.1 Project Description

This project is the initial assessment of selected individual areas at the Iowa Army Ammunitions Plant (IAAAP) that are potentially affected by various modes of radiological contamination. These areas have been identified by USACE. The initial assessment of these areas was accomplished by conducting building surveys, gamma walkovers and soil sampling. Sampling was conducted in general accordance with protocols from the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and the project-developed *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004).

A-1.2 Project Objectives

The objective of this radiological screening survey is the resolution of whether or not the soil and man-made materials (i.e., pavements, floors in and around structures) present at the surface of areas identified by the preliminary assessment (PA) (USACE, 2001) as having low probability for radioactive contamination are radioactively contaminated.

A-1.3 Project Implementation

The proposal for this project was submitted to the United States Army Corps of Engineers (USACE) in January 2004 and subsequently authorized in August 2004. The sampling was conducted in August of 2004. Radiological analyses were conducted by the onsite Formerly Utilized Sites Remedial Action Program (FUSRAP) laboratory at the Hazelwood Interim Storage Site (HISS); with quality assurance (QA) split samples analyzed by a contract laboratory, Severn-Trent Laboratories.

A-1.4 Purpose of this Report

The primary intent of this assessment is to illustrate that data generated from this sampling can withstand scientific scrutiny, are appropriate for their intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy.

A-2 QUALITY ASSURANCE PROGRAM

A quality assurance project plan (QAPP) was prepared for this project and is based upon the Sampling and Analysis Guide (SAG) (USACE 2000) developed for the St. Louis FUSRAP Sites. The QAPP established requirements for both field and laboratory quality control (QC) procedures. In general, analytical laboratory QC duplicates, matrix spikes, laboratory control samples, and method blanks were required for every 20 field samples or less of each matrix and analyte types.

One of the primary goals of the QA program is to ensure that the quality of results for environmental measurements is appropriate for the intended use of the data. To this end, a QAPP and standardized field procedures were compiled to guide the investigation. Through the process of readiness review, training, equipment calibration, QC implementation, and detailed documentation, the project has successfully accomplished the goals set by the QA Program.

EPA "definitive" data have been reported including the following basic information:

a. laboratory case narratives
b. sample results
c. laboratory method blank results
d. laboratory control standard results
e. laboratory sample matrix spike recoveries
f. laboratory duplicate results
g. surrogate recoveries (Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), Pesticide/Polychlorinated Biphenyls (PCBs))
h. sample extraction dates
i. sample analysis dates

This information from the laboratory, along with field information, provides the basis for subsequent data evaluation relative to sensitivity, precision, accuracy, representativeness and completeness. These parameters are presented in Section A-4.

A-3 DATA VALIDATION

This project implemented the use of data validation checklists to facilitate laboratory data validation. These checklists were completed by the project designated validation staff and were reviewed by the project laboratory coordinator. Data validation checklists for each laboratory sample delivery group (SDG) are retained with laboratory data deliverables by SAIC.

A-3.1 Laboratory Data Validation

Analytical data generated for this project have been subjected to a process of data verification, validation, and review. Several criteria were established against which the data are compared and from which a judgment is rendered regarding the acceptance and qualification of the data. Because it is beyond the scope of this report to cite those criteria, the reader is directed to the following documents for specific detail:

- *USACE Kansas City and St. Louis Districts Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy, December 17, 2002*.
- SAIC, Technical Support Contractor, QA Technical Procedure (TP-DM-300-7) *Data Verification and Validation*.

Upon receipt of field and analytical data, the verification staff performed a systematic examination of the reports, following standardized data package checklists, to verify the content, presentation, and administrative validity of the data. In conjunction with the data package verification, laboratory electronic data diskettes were available. These diskette deliverables were subjected to review and verification against the hardcopy deliverable. Both a structural and technical assessment of the laboratory-delivered electronic reports were performed. The structural evaluation verified that the required data had been reported and that contract specified requirements were met (i.e., analytical holding times, contractual turnaround times, etc.).

During the validation phase of the review and evaluation process, data were subjected to a systematic technical review by examining the field and analytical QC results and laboratory documentation. The systematic technical review followed appropriate guidelines for laboratory data validation. These data validation guidelines define the technical review criteria, methods for evaluation of the criteria, and actions to be taken resulting from the review of these criteria. The primary objective of this phase was to assess and summarize the quality and reliability of the data for the intended use and to document factors that may affect the usability of the data. Data verification/validation included, but was not necessarily limited to, the following parameters:

Method Requirements
Requirements for all methods: - Holding time information and methods requested - Discussion of laboratory analysis, including any laboratory problems ***Radiochemical Analysis*** - Sample results - Initial calibration - Efficiency check - Background determinations - Spike recovery results - Internal standard results (tracers or carriers) - Duplicate results - Self-absorption factor (α,β) - Cross-talk factor (α,β) - Laboratory control samples (LCS) - Run log

As an end result of this phase of the review, the data were qualified based on the technical assessment of the validation criteria. Qualifiers were applied to each field and analytical result to indicate the usability of the data for its intended purpose. The majority of estimated values were assigned to analyte concentrations observed between the reporting level and method detection levels. The data has been appropriately identified and qualified.

A-3.2 Definition of Data Qualifiers (Flags)

During the data validation process, the laboratory data were assigned appropriate data validation flags and reason codes. Validation flags are defined as follows:

"=" Positive Result.

"U" When the material was analyzed for but not detected above the level of the associated value.

"J" When the associated value is an estimated quantity. Indicating there is cause to question accuracy or precision of the reported value.

"UJ" When the analyte was analyzed for but not detected above the associated value; however, the reported value is an estimate and demonstrates a decreased knowledge of its accuracy or precision.

"R" When the analyte value reported is unusable. The integrity of the analyte's identification, accuracy, precision, or sensitivity have raised significant question as to the reality of the information presented.

SAIC validation flagging codes and copies of validation checklists and qualified data forms are on-file with the analytical laboratory deliverable.

A-4 DATA EVALUATION

A-4.1 Accuracy

Accuracy provides a gauge or measure of the agreement between an observed result and the true value for an analysis. Analytical accuracy is evaluated by measuring the agreement between an analytical result and its known or true value. This is generally determined through use of laboratory control samples (LCSs), matrix spike (MS) analysis, and performance evaluation (PE) samples. Accuracy, as measured through the use of LCSs, determines the method's implementation of accuracy independent of sample matrix, as well as document laboratory analytical process control. Accuracy determined by the MS is a function of both matrix and analytical process.

A-4.1.1 Radiological Parameters

Individual sample chemical yields and LCS recoveries were within the ± 25 percent criteria for the verification samples, and therefore, the data can be used for its intended purpose.

A-4.1.2 Inter-Laboratory Accuracy

As a measure of analytical accuracy, relative percent differences (RPD) for split sample pairs for the two radiological analytical groups (i.e., alpha spectroscopy and gamma spectroscopy) were evaluated by using an independent contract laboratory. Sample homogeneity, analytical method performance, and the quantity of analyte being measured contribute to this measure of sample analytical accuracy.

As the RPD approaches zero, complete agreement between the split sample pairs is achieved. When one or both sample values were between the quantitation level and less than five times the analyte reporting level, the normalized absolute difference (NAD) was evaluated. If both samples were not detected for a given analyte, then the precision was considered acceptable.

The analytical accuracy (i.e., split precision) between the FUSRAP laboratory and the contract laboratory met the SAG goal of ensuring that 90 percent of the IAAAP samples were within either the ±30 percent criteria for RPD data quality indicator (DQI) or less than 1.96 for the NAD DQI (Tables A-4-1 and A-4-2). All samples were within the control limits for either RPD or NAD.

Table A-4-1. Split Precision Among Alpha Spectroscopy Analyses

	Uranium-234		Uranium-235		Uranium-238	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-2	14.6%	NA	NC	NC	NA	0.74
IAAP84202/IAAP84202-2	NA	1.02	NC	NC	NA	0.65
IAAP84214/IAAP84214-2	13.4%	NA	NC	NC	20.9%	NA
IAAP84240/IAAP84240-2	1.3%	NA	NC	NC	5.2%	NA

NC **–** Value not calculated due to one or both of the results were non-detected.
NA **–** Not applicable**.**

Table A-4-2. Split Precision Among Gamma Spectroscopy Analyses

	Actinium-227		Am-241		Cesium-137		Potassium-40		Protactinium-231		Radium-226		Radium-228		Thorium-228		Thorium-230		Thorium-232	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-2	NC	NC	NC	NC	21.6%	NA	12.7%	NA	NC	NC	24.2%	NA	5.7%	NA	NC	NC	NC	NC	5.7%	NA
IAAP84202/IAAP84202-2	NC	NC	NC	NC	NC	NC	0.2%	NA	NC	NC	10.0%	NA	3.0%	NA	NC	NC	NC	NC	3.0%	NA
IAAP84214/IAAP84214-2	NC	NC	NC	NC	NC	NC	7.0%	NA	NC	NC	24.5%	NA	6.1%	NA	NC	NC	NC	NC	6.1%	NA
IAAP84240/IAAP84240-2	NC	NC	NC	NC	19.2%	NA	11.9%	NA	NC	NC	22.7%	NA	15.2%	NA	NC	NC	NC	NC	15.2%	NA

NC – Value not calculated due to one or both of the results were non-detected.
NA – Not applicable.

A-4.2 Precision

A-4.2.1 Laboratory Precision

To evaluate precision within the on-site laboratory, lab duplicate samples were employed at a frequency of one duplicate per sample batch (no more than one duplicate per thirteen samples). As a measure of analytical precision, the RPD for laboratory duplicate sample pairs for the two radiological analytical groups (i.e., alpha spectroscopy and gamma spectroscopy) were employed at the time of verification and validation.

RPD and/or NAD values for the analytes were within the ±30% window of acceptance for the verification samples. Results are presented in Table A-4-3 and A-4-4.

A-4.2.2 Field Precision

Field duplicate samples were collected to ascertain the contribution to variability (i.e., precision) due to the combination of environmental media, sampling consistency, and analytical precision. Each field duplicate was collected from the same spatial and temporal conditions as the associated primary environmental sample. Soil samples were collected using the same sampling device and after homogenization for all analytes.

For the four field duplicate samples collected for the verification activities, the NAD and RPD values indicated good precision for the data. The sample pairs had RPDs or NADs that were within the control limits.

Table A-4-3. Field Duplicate Precision Among Alpha Spectroscopy Analyses

	Uranium-234		Uranium-235		Uranium-238	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-1	11.1%	NA	NC	NC	24.6%	NA
IAAP84202/IAAP84202-1	29.1%	NA	NC	NC	5.3%	NA
IAAP84214/IAAP84214-1	NA	0.76	NC	NC	10.1%	NA
IAAP84240/IAAP84240-1	28.8%	NA	NC	NC	19.5%	NA

NC – Value not calculated due to one or both of the results were non-detected.
NA – Not applicable.

Table A-4-4. Field Duplicate Precision Among Gamma Spectroscopy Analyses

	Actinium-227		Am-241		Cesium-137		Potassium-40		Protactinium-231		Radium-226		Radium-228		Thorium-228		Thorium-230		Thorium-232	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-1	NC	NC	NC	NC	4.5%	NA	0.6%	NA	NC	NC	4.6%	NA	1.7%	NA	1.7%	NA	NC	NC	1.7%	NA
IAAP84202/IAAP84202-1	NC	NC	NC	NC	14.8%	NA	0.2%	NA	NC	NC	5.3%	NA	4.8%	NA	4.8%	NA	NC	NC	4.8%	NA
IAAP84214/IAAP84214-1	NC	NC	NC	NC	8.4%	NA	1.7%	NA	NC	NC	7.4%	NA	5.1%	NA	5.1%	NA	NC	NC	5.1%	NA
IAAP84240/IAAP84240-1	NC	NC	NC	NC	11.2%	NA	4.1%	NA	NC	NC	22.3%	NA	8.2%	NA	8.2%	NA	NC	NC	8.2%	NA

NC – Value not calculated due to one or both of the results were non-detected.
NA – Not applicable.

A-4.3 Sensitivity

Determination of minimum detectable values allows the investigation to assess the relative confidence which can be placed in a value in comparison to the magnitude or level of analyte concentration observed. The closer a measured value is to the minimum detectable concentration, the less confidence and more variation the measurement will have. Project sensitivity goals were expressed as quantitation level goals in the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004). These levels were achieved or exceeded throughout the analytical process.

A-4.4 Representativeness and Comparability

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for an environmental site and is the qualitative term most concerned with the proper design of a sampling program. Factors that affect the representativeness of analytical data include proper preservation, holding times, use of standard sampling and analytical methods, and determination of matrix or analyte interferences. Sample preservation, analytical methodologies, and soil sampling methodologies were documented to be adequate and consistently applied.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. These investigations employed appropriate sampling methodologies, site surveillance, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through the proper implementation and documentation of these standard practices, the project has established the confidence that the data will be comparable to other project and programmatic information.

A-4.5 Completeness

Usable data are defined as those data, which pass individual scrutiny during the verification and validation process and are accepted for unrestricted use. The data quality objective of achieving 90 percent completeness, as defined in the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004) was satisfied with the project producing valid results for 100 percent of the sample analyses performed and successfully collected.

A total of sixty (60) random verification and five biased soil samples were collected with approximately 940 discrete analyses (i.e., analytes) being obtained, reviewed, and integrated into the assessment. The project produced acceptable results for 100.0 percent of the sample analyses performed.

A-4.5 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of the IAAAP information meets or exceeds the established project objectives. Through proper implementation of the project data verification, validation, and assessment process, project information has been determined to be acceptable for use.

Data, as presented, have been qualified as usable, but estimated when necessary. Data that have been estimated have concentrations/activities that are below the quantitation limit or are indicative of accuracy, precision, or sensitivity being less than desired but adequate for interpretation.

Data produced for this survey demonstrates that it can withstand scientific scrutiny, is appropriate for its intended purpose, is technically defensible, and is of known and acceptable sensitivity, precision, and accuracy. Data integrity has been documented through proper implementation of QA and QC measures. The environmental information presented has an established confidence, which allows utilization for the project objectives and provides data for future needs.

ATTACHMENT B

ANALYTICAL DATA WITH QUALIFIERS

			Actinium-227			Am-241			Cesium-137			Protactinium-231			Potassium-40			Radium-226			Radium-228			Thorium-228			Thorium-230			Thorium-232			Uranium-234			Uranium-235			Uranium-238		
Station	Sample	Units	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit	Qual	Result	Detect Limit
IAAP84180	IAAP84180	pCi/g	UJ	-0.043	0.116	UJ	0.005	0.041	=	0.081	0.017	UJ	0.047	0.428	=	11.900	0.093	J	0.885	0.040	J	0.790	0.036	J	0.790	0.036	UJ	0.599	3.904	J	0.790	0.036	J	0.653	0.290	UJ	0.060	0.162	J	0.842	0.289
IAAP84181	IAAP84181	pCi/g	UJ	-0.032	0.153	UJ	0.006	0.055	=	0.110	0.018	UJ	0.172	0.592	=	14.180	0.163	=	1.240	0.057	J	0.993	0.056	=	0.993	0.056	UJ	1.068	5.058	UJ	0.993	0.056	J	1.025	0.163	U	0.000	0.202	J	0.645	0.302
IAAP84181	IAAP84182	pCi/g	UJ	-0.269	0.436	UJ	-0.032	0.155	=	0.543	0.077	UJ	0.707	1.942	=	17.330	0.661	=	1.469	0.180	=	1.245	0.196	=	1.245	0.196	UJ	-1.426	14.170	UJ	1.245	0.196	J	1.231	0.185	UJ	0.084	0.229	J	1.430	0.185
IAAP84183	IAAP84183	pCi/g	UJ	-0.077	0.138	UJ	0.018	0.046	=	0.214	0.022	UJ	0.220	0.589	=	14.980	0.174	=	1.048	0.052	J	1.012	0.051	J	1.012	0.051	UJ	-0.706	4.252	J	1.012	0.051	=	1.267	0.389	UJ	0.065	0.177	=	1.143	0.265
IAAP84184	IAAP84184	pCi/g	UJ	-0.025	0.150	UJ	0.010	0.049	=	0.323	0.026	UJ	-0.150	0.596	=	15.410	0.162	=	1.123	0.055	J	1.030	0.055	J	1.030	0.055	UJ	0.467	4.610	J	1.030	0.055	J	1.042	0.296	UJ	0.036	0.434	J	0.687	0.294
IAAP84184	IAAP84184-1	pCi/g	UJ	0.039	0.147	UJ	0.017	0.048	=	0.309	0.023	UJ	0.368	0.644	=	15.500	0.203	=	1.073	0.056	J	1.013	0.054	J	1.013	0.054	UJ	-1.959	4.513	J	1.013	0.054	=	1.165	0.247	UJ	0.061	0.164	J	0.879	0.132
IAAP84184	IAAP84184-2	pCi/g	U	0.130	0.500	U	0.009	0.210	=	0.260	0.120	U	-1.200	2.100	=	17.500	1.200	=	0.880	0.570	=	1.090	0.390	-	-	-	-	-	-	=	1.090	0.390	=	0.900	0.100	U	0.031	0.930	U	1.200	2.200
IAAP84185	IAAP84185	pCi/g	UJ	-0.087	0.144	UJ	0.003	0.048	=	0.308	0.020	UJ	0.404	0.640	=	14.790	0.184	=	1.021	0.052	J	0.887	0.054	J	0.887	0.054	UJ	1.453	4.549	J	0.887	0.054	J	0.836	0.267	UJ	0.066	0.178	J	0.740	0.143
IAAP84186	IAAP84186	pCi/g	UJ	-0.004	0.108	UJ	0.014	0.038	=	0.036	0.018	UJ	0.241	0.493	=	11.090	0.154	=	0.825	0.040	J	0.758	0.039	J	0.758	0.039	UJ	1.081	3.534	J	0.758	0.039	=	1.386	0.314	UJ	-0.016	0.325	J	0.612	0.262
IAAP84187	IAAP84187	pCi/g	UJ	-0.054	0.117	UJ	0.015	0.043	U	0.013	0.017	UJ	0.147	0.474	=	10.810	0.098	J	0.692	0.046	J	0.846	0.044	J	0.846	0.044	UJ	1.088	4.143	J	0.846	0.044	J	0.848	0.416	UJ	0.140	0.189	=	1.281	0.284
IAAP84188	IAAP84188	pCi/g	UJ	-0.004	0.101	UJ	0.005	0.034	U	0.014	0.015	UJ	0.212	0.438	=	10.800	0.148	=	0.593	0.038	J	0.600	0.039	J	0.600	0.039	UJ	1.340	3.287	J	0.600	0.039	J	0.525	0.118	UJ	0.054	0.146	J	0.772	0.219
IAAP84189	IAAP84189	pCi/g	UJ	0.041	0.113	UJ	0.011	0.039	UJ	0.001	0.015	UJ	-0.069	0.402	J	10.340	0.121	J	0.669	0.038	J	0.676	0.039	J	0.676	0.039	UJ	-0.254	3.657	J	0.676	0.039	J	0.468	0.269	UJ	-0.033	0.396	J	0.573	0.268
IAAP84190	IAAP84190	pCi/g	UJ	0.003	0.101	UJ	-0.013	0.034	UJ	0.005	0.013	UJ	-0.092	0.377	=	9.861	0.079	J	0.613	0.032	J	0.670	0.034	J	0.670	0.034	UJ	-0.390	3.317	J	0.670	0.034	J	0.586	0.275	U	0.000	0.182	J	0.760	0.147
IAAP84191	IAAP84191	pCi/g	UJ	-0.056	0.153	UJ	-0.040	0.048	=	0.073	0.020	UJ	0.050	0.593	=	13.460	0.171	=	1.046	0.051	J	0.858	0.047	J	0.858	0.047	UJ	-1.817	4.686	J	0.858	0.047	=	1.192	0.289	UJ	0.071	0.192	J	1.144	0.155
IAAP84194	IAAP84194	pCi/g	UJ	-0.024	0.123	UJ	0.033	0.050	=	0.118	0.017	UJ	-0.093	0.524	=	13.520	0.139	=	1.196	0.048	J	0.857	0.048	J	0.857	0.048	UJ	2.009	4.595	J	0.857	0.048	J	1.048	0.158	UJ	0.144	0.195	J	1.160	0.157
IAAP84195	IAAP84195	pCi/g	UJ	0.000	0.136	UJ	0.018	0.052	=	0.042	0.019	UJ	0.175	0.610	=	14.990	0.173	=	1.411	0.050	J	0.959	0.055	J	0.959	0.055	UJ	-1.188	4.952	J	0.959	0.055	=	1.526	0.188	U	0.000	0.232	J	1.382	0.187
IAAP84196	IAAP84196	pCi/g	UJ	-0.071	0.127	UJ	0.011	0.048	=	0.078	0.016	UJ	0.128	0.521	=	12.550	0.141	=	1.192	0.047	J	0.855	0.045	J	0.855	0.045	UJ	0.158	4.628	J	0.855	0.045	=	1.338	0.145	J	0.264	0.179	=	1.332	0.144
IAAP84197	IAAP84197	pCi/g	UJ	-0.031	0.126	UJ	0.009	0.044	=	0.076	0.017	UJ	-0.066	0.540	=	12.170	0.143	=	1.056	0.047	J	0.804	0.045	J	0.804	0.045	UJ	-0.657	4.308	J	0.804	0.045	=	0.977	0.132	UJ	-0.030	0.362	=	0.973	0.132
IAAP84198	IAAP84198	pCi/g	UJ	0.086	0.131	UJ	0.029	0.052	=	0.121	0.018	UJ	0.352	0.568	=	14.160	0.150	=	1.211	0.048	J	0.936	0.045	J	0.936	0.045	UJ	-0.988	4.669	J	0.936	0.045	=	1.163	0.282	U	0.000	0.188	=	1.326	0.281
IAAP84199	IAAP84199	pCi/g	UJ	-0.035	0.106	UJ	-0.001	0.034	=	0.073	0.019	UJ	0.300	0.478	=	9.016	0.127	J	0.914	0.042	J	0.536	0.039	J	0.536	0.039	UJ	0.864	3.493	J	0.536	0.039	=	1.392	0.164	J	0.224	0.202	=	1.326	0.163
IAAP84200	IAAP84200	pCi/g	UJ	0.011	0.123	UJ	-0.023	0.037	=	0.498	0.016	UJ	0.102	0.512	=	8.216	0.132	=	1.040	0.040	J	0.528	0.044	J	0.528	0.044	U	3.137	4.014	J	0.528	0.044	=	2.083	0.171	UJ	-0.020	0.392	=	3.064	0.317
IAAP84201	IAAP84201	pCi/g	UJ	-0.123	0.152	UJ	0.014	0.040	J	0.02*	0.020	UJ	-0.077	0.708	=	10.330	0.162	J	0.896	0.062	J	0.722	0.056	=	0.722	0.056	UJ	0.884	3.908	=	0.722	0.056	J	1.223	0.174	UJ	0.079	0.215	J	0.577	0.174
IAAP84202	IAAP84202	pCi/g	UJ	-0.059	0.111	UJ	0.025	0.041	=	0.037	0.017	UJ	0.206	0.504	=	12.220	0.124	=	1.039	0.043	J	0.773	0.043	J	0.773	0.043	UJ	-2.248	3.748	J	0.773	0.043	=	1.237	0.140	U	0.000	0.172	=	1.283	0.139
IAAP84202	IAAP84202-1	pCi/g	UJ	-0.055	0.136	UJ	-0.016	0.047	J	0.032	0.021	UJ	0.226	0.592	=	12.190	0.120	=	1.095	0.049	J	0.737	0.049	J	0.737	0.049	UJ	-2.965	4.542	J	0.737	0.049	J	0.922	0.132	U	0.000	0.162	=	1.353	0.131
IAAP84202	IAAP84202-2	pCi/g	U	0.420	0.550	U	0.029	0.170	U	0.048	0.140	U	0.100	2.200	=	12.200	1.100	=	0.940	0.520	=	0.750	0.650	-	-	-	-	-	-	=	0.750	0.650	=	0.650	0.120	U	0.270	1.200	U	0.900	1.800
IAAP84203	IAAP84203	pCi/g	UJ	-0.025	0.128	UJ	0.008	0.048	=	0.163	0.019	UJ	0.211	0.533	=	14.170	0.159	=	1.310	0.044	J	0.984	0.045	J	0.984	0.045	UJ	1.026	4.849	J	0.984	0.045	=	0.971	0.132	U	0.000	0.162	=	1.451	0.131
IAAP84204	IAAP84204	pCi/g	UJ	-0.091	0.098	UJ	-0.016	0.034	=	0.142	0.014	UJ	-0.070	0.455	=	8.720	0.089	J	0.920	0.039	J	0.597	0.037	J	0.597	0.037	UJ	-2.313	3.310	J	0.597	0.037	J	0.760	0.129	UJ	0.059	0.159	J	0.745	0.238
IAAP84205	IAAP84205	pCi/g	UJ	0.002	0.124	UJ	-0.003	0.049	J	0.024	0.018	U	0.464	0.549	=	13.720	0.132	=	1.191	0.051	J	1.019	0.048	J	1.019	0.048	UJ	-0.830	4.837	J	1.019	0.048	J	0.655	0.111	U	0.000	0.137	=	0.897	0.110
IAAP84208	IAAP84208	pCi/g	UJ	0.046	0.149	UJ	0.002	0.046	=	0.097	0.024	UJ	0.217	0.607	=	14.970	0.187	J	1.074	0.052	J	0.943	0.057	=	0.943	0.057	UJ	0.764	4.422	=	0.943	0.057	J	0.970	0.292	UJ	0.143	0.194	J	1.095	0.156
IAAP84209	IAAP84209	pCi/g	UJ	0.004	0.166	UJ	0.018	0.051	=	0.397	0.026	UJ	-0.204	0.650	=	16.530	0.189	=	1.222	0.060	J	0.921	0.057	J	0.921	0.057	UJ	-1.653	4.726	J	0.921	0.057	J	0.851	0.312	UJ	0.286	0.384	=	1.294	0.167
IAAP84210	IAAP84210	pCi/g	UJ	0.096	0.162	UJ	-0.012	0.050	=	0.465	0.026	UJ	0.043	0.681	=	17.750	0.217	=	1.130	0.062	J	0.970	0.060	J	0.970	0.060	UJ	0.866	4.682	J	0.970	0.060	J	0.928	0.249	UJ	-0.015	0.307	=	1.183	0.134
IAAP84211	IAAP84211	pCi/g	UJ	-0.080	0.179	UJ	-0.001	0.057	=	0.395	0.026	UJ	0.044	0.755	=	16.020	0.245	=	1.247	0.066	J	1.075	0.066	J	1.075	0.066	U	3.701	5.234	J	1.075	0.066	=	1.571	0.285	UJ	0.192	0.352	=	1.226	0.284
IAAP84212	IAAP84212	pCi/g	UJ	-0.076	0.163	UJ	0.027	0.052	=	0.436	0.023	UJ	-0.070	0.637	=	15.470	0.204	=	1.231	0.061	=	1.096	0.065	=	1.096	0.065	UJ	1.220	4.915	=	1.096	0.065	J	1.198	0.141	UJ	0.113	0.324	=	1.297	0.141
IAAP84213	IAAP84213	pCi/g	U	0.176	0.184	UJ	0.014	0.053	=	0.529	0.023	UJ	0.251	0.702	=	14.580	0.232	=	1.111	0.062	J	0.897	0.069	J	0.897	0.069	UJ	0.306	4.907	J	0.897	0.069	=	1.270	0.143	UJ	0.065	0.177	=	1.159	0.143
IAAP84214	IAAP84214	pCi/g	UJ	-0.015	0.168	UJ	-0.012	0.050	=	0.175	0.022	UJ	0.320	0.648	=	16.300	0.194	=	1.215	0.054	J	0.970	0.057	J	0.970	0.057	UJ	4.233	4.629	J	0.970	0.057	=	1.075	0.314	UJ	0.129	0.175	=	1.135	0.263
IAAP84214	IAAP84214-1	pCi/g	UJ	0.040	0.179	UJ	0.026	0.052	=	0.191	0.026	UJ	0.170	0.668	=	16.020	0.194	=	1.308	0.054	J	1.020	0.064	J	1.020	0.064	UJ	-1.298	4.957	J	1.020	0.064	=	1.778	0.155	U	0.000	0.192	=	1.256	0.155
IAAP84214	IAAP84214-2	pCi/g	U	0.280	0.490	U	0.110	0.210	U	0.107	0.180	U	-1.600	2.000	=	15.200	0.800	=	0.950	0.600	=	1.030	0.800	-	-	-	-	-	-	=	1.030	0.800	=	0.940	0.080	U	0.017	0.920	U	1.700	2.100
IAAP84215	IAAP84215	pCi/g	UJ	0.051	0.160	UJ	0.021	0.049	=	0.127	0.023	UJ	-0.315	0.615	=	16.940	0.221	=	1.364	0.058	J	0.929	0.058	J	0.929	0.058	UJ	-0.013	4.588	J	0.929	0.058	=	0.679	0.263	UJ	0.054	0.147	=	0.873	0.118
IAAP84216	IAAP84216	pCi/g	UJ	0.070	0.178	UJ	-0.001	0.052	UJ	-0.009	0.026	UJ	0.376	0.703	=	16.890	0.214	=	1.231	0.065	J	1.078	0.062	J	1.078	0.062	UJ	0.340	5.016	J	1.078	0.062	J	0.964	0.373	UJ	-0.019	0.386	J	0.743	0.168
IAAP84217	IAAP84217	pCi/g	UJ	0.020	0.172	UJ	-0.006	0.052	=	0.109	0.027	UJ	-0.073	0.680	=	16.180	0.220	=	1.368	0.058	=	1.107	0.061	=	1.107	0.061	U	4.281	4.964	=	1.107	0.061	J	0.722	0.150	UJ	0.069	0.186	=	1.147	0.278
IAAP84218	IAAP84218	pCi/g	UJ	0.139	0.142	UJ	0.015	0.049	UJ	-0.006	0.017	UJ	-0.111	0.513	=	10.080	0.106	J	0.970	0.048	J	0.954	0.049	J	0.954	0.049	UJ	-0.148	4.677	J	0.954	0.049	J	0.766	0.148	U	0.000	0.183	J	0.586	0.274
IAAP84219	IAAP84219	pCi/g	UJ	-0.026	0.127	UJ	0.006	0.046	UJ	0.005	0.017	UJ	0.197	0.485	=	14.200	0.126	=	1.162	0.042	=	1.062	0.044	=	1.062	0.044	UJ	1.099	4.443	=	1.062	0.044	J	1.190	0.170	UJ	0.058	0.389	=	1.372	0.169
IAAP84222	IAAP84222	pCi/g	UJ	-0.099	0.139	UJ	0.000	0.047	J	0.057	0.021	U	0.438	0.625	=	13.840	0.170	=	1.073	0.053	J	0.931	0.055	J	0.931	0.055	U	3.512	4.405	J	0.931	0.055	J	0.971	0.146	U	0.000	0.180	J	1.061	0.271
IAAP84223	IAAP84223	pCi/g	UJ	-0.110	0.142	UJ	0.018	0.048	=	0.301	0.021	UJ	-0.022	0.635	=	14.720	0.187	=	1.053	0.057	J	0.922	0.054	J	0.922	0.054	UJ	1.786	4.478	J	0.922	0.054	J	0.728	0.267	UJ	0.131	0.177	J	1.002	0.143
IAAP84224	IAAP84224	pCi/g	UJ	0.049	0.483	UJ	-0.024	0.160	=	0.573	0.077	UJ	-1.323	2.242	=	17.800	0.670	=	1.322	0.209	J	1.212	0.217	J	1.212	0.217	UJ	-3.661	15.060	J	1.212	0.217	=	1.705	0.178	U	0.000	0.219	J	0.980	0.329
IAAP84225	IAAP84225	pCi/g	UJ	-0.445	0.464	UJ	0.080	0.168	=	0.531	0.082	UJ	0.441	2.241	=	18.560	0.519	=	1.529	0.195	J	1.148	0.206	J	1.148	0.206	UJ	-2.549	14.280	J	1.148	0.206	=	1.625	0.285	UJ	0.139	0.189	=	1.800	0.153
IAAP84226	IAAP84226	pCi/g	UJ	-0.061	0.149	UJ	0.020	0.049	=	0.407	0.023	UJ	0.333	0.690	=	15.780	0.174	=	1.164	0.062	J	0.866	0.060	J	0.866	0.060	UJ	0.803	4.754	J	0.866	0.060	J	1.006	0.151	UJ	0.121	0.347	J	0.862	0.334
IAAP84227	IAAP84227	pCi/g	U	0.135	0.143	UJ	0.007	0.047	=	0.312	0.025	UJ	0.250	0.637	=	12.030	0.162	=	1.045	0.056	J	0.804	0.055	J	0.804	0.055	J	7.499	4.189	J	0.804	0.055	J	2.030	0.518	J	1.015	0.344	J	1.535	0.277
IAAP84228	IAAP84228	pCi/g	UJ	-0.168	0.136	UJ	0.005	0.048	J	0.020	0.016	UJ	0.082	0.509	=	15.490	0.107	J	0.985	0.047	J	0.922	0.043	J	0.922	0.043	U	1.551	4.583	J	0.922	0.043	=	1.041	0.128	U	0.000	0.158	J	0.459	0.237
IAAP84229	IAAP84229	pCi/g	U	-0.038	0.124	U	0.007	0.046	J	0.121	0.017	U	0.177	0.518	=	13.130	0.142	J	0.845	0.046	J	0.827	0.051	J	0.827	0.051	UJ	3.836	4.198	J	0.827	0.051	J	0.956	0.327	UJ	0.080	0.217	J	0.710	0.175
IAAP84230	IAAP84230	pCi/g	UJ	-0.049	0.125	UJ	0.000	0.044	=	0.046	0.016	UJ	0.162	0.485	=	12.880	0.127	J	0.965	0.043	J	0.809	0.045	J	0.809	0.045	UJ	0.480	4.279	J	0.809	0.045	=	1.072	0.126	U	0.000	0.156	=	1.010	0.234
IAAP84231	IAAP84231	pCi/g	UJ	0.060	0.123	UJ	-0.006	0.042	=	0.070	0.017	UJ	-0.010	0.481	=	12.400	0.138	J	0.766	0.044	J	0.753	0.042	J	0.753	0.042	UJ	1.002	4.044	=	0.753	0.042	J	0.835	0.267	J	0.196	0.177	J	0.791	0.143
IAAP84232	IAAP84232	pCi/g	UJ	0.078	0.142	UJ	0.005	0.049	=	0.099	0.024	UJ	0.217	0.621	=	12.750	0.181	=	1.202	0.058	J	0.831	0.053	J	0.831	0.053	UJ	1.333	4.560	J	0.831	0.053	=	1.859	0.343	U	0.000	0.191	J	0.883	0.342
IAAP84233	IAAP84233	pCi/g	UJ	0.030	0.116	U	0.042	0.046	=	0.063	0.015	UJ	0.258	0.528	=	9.415	0.139	=	1.053	0.042	J	0.496	0.046	J	0.496	0.046	UJ	-1.497	3.957	J	0.496	0.046	J	0.746	0.144	UJ	-0.016	0.331	J	0.570	0.267
IAAP84234	IAAP84234	pCi/g	UJ	0.026	0.141	UJ	0.019	0.048	=	0.603	0.021	UJ	0.269	0.639	=	10.000	0.169	=	1.298	0.058	J	0.587	0.057	J	0.587	0.057	UJ	0.749	4.519	J	0.587	0.057	J	1.005	0.160	UJ	0.055	0.367	=	1.560	0.353
IAAP84235	IAAP84235	pCi/g	UJ	-0.001	0.164	UJ	0.004	0.052	=	0.424	0.023	UJ	0.028	0.651	=	14.470	0.188	=	1.294	0.060	J	0.915	0.061	J	0.915	0.061	UJ	-2.269	4.714	J	0.915	0.061	=	1.373	0.177	UJ	0.081	0.219	J	1.220	0.328
IAAP84236	IAAP84236	pCi/g	UJ	-0.112	0.154	UJ	0.029	0.050	=	0.387	0.024	UJ	0.260	0.664	=	12.180	0.218	=	1.134	0.060	J	0.888	0.061	J	0.888	0.061	UJ	0.706	4.667	J	0.888	0.061	=	1.223	0.297	UJ	-0.018	0.575	J	1.115	0.432
IAAP84237	IAAP84237	pCi/g	UJ	-0.013	0.102	UJ	0.014	0.032	=	0.497	0.017	UJ	0.191	0.481	=	5.557	0.147	J	0.887	0.039	J	0.283	0.039	J	0.283	0.039	UJ	-0.565	3.017	J	0.283	0.039	J	0.598	0.280	UJ	0.069	0.186	J	0.776	0.150
IAAP84238	IAAP84238	pCi/g	UJ	-0.016	0.083	UJ	0.001	0.031	=	0.182	0.011	UJ	0.179	0.365	=	5.573	0.088	J	0.716	0.030	J	0.284	0.032	J	0.284	0.032	UJ	-0.127	2.845	=	0.284	0.032	J	0.442	0.120	UJ	-0.014	0.274	J	0.814	0.264
IAAP84239	IAAP84239	pCi/g	UJ	0.013	0.130	UJ	0.020	0.047	=	0.442	0.020	UJ	0.006	0.487	=	9.696	0.102	J	0.885	0.050	J	0.910	0.043	J	0.910	0.043	UJ	0.761	4.404	J	0.910	0.043	J	0.550	0.217	U	0.000	0.144	=	0.860	0.117
IAAP84240	IAAP84240	pCi/g	UJ	-0.174	0.360	UJ	0.008	0.124	=	0.643	0.058	UJ	0.108	1.492	=	13.970	0.484	J	1.168	0.159	J	1.060	0.130	J	1.060	0.130	UJ	0.161	10.750	J	1.060	0.130	J	0.790	0.224	U	0.000	0.149	J	0.643	0.266
IAAP84240	IAAP84240-1	pCi/g	UJ	0.008	0.367	UJ	0.032	0.139	=	0.574	0.061	U	1.181	1.794	=	14.560	0.406	=	1.461	0.143	J	0.977	0.150	J	0.977	0.150	UJ	-4.397	11.400	J	0.977	0.150	J	1.056	0.325	UJ	0.067	0.181	J	0.782	0.323
IAAP84240	IAAP84240-2	pCi/g	U	-0.050	0.490	U	-0.006	0.210	=	0.530	0.130	U	-1.100	2.500	=	12.400	0.300	=	0.930	0.610	=	0.910	0.370	-	-	-	-	-	-	=	0.910	0.370	=	0.780	0.110	U	0.280	1.300	U	1.000	2.300
IAAP84241	IAAP84241	pCi/g	UJ	-0.038	0.143	UJ	0.014	0.050	=	0.370	0.020	UJ	-0.073	0.594	=	13.620	0.144	=	1.008	0.053	J	0.931	0.051	J	0.931	0.051	UJ	1.020	4.812	J	0.931	0.051	J	0.951	0.143	U	0.000	0.177	J	0.776	0.265
IAAP84242	IAAP84242	pCi/g	UJ	0.067	0.143	UJ	0.005	0.046	=	0.474	0.021	UJ	0.003	0.541	=	12.600	0.165	J	0.950	0.044	J	0.737	0.046	J	0.737	0.046	UJ	-0.860	4.430	J	0.737	0.046	J	0.570	0.244	UJ	0.030	0.359	J	0.483	0.131
IAAP84243	IAAP84243	pCi/g	UJ	0.032	0.168	UJ	-0.001	0.056	=	0.314	0.024	UJ	0.210	0.649	=	16.560	0.168	=	1.272	0.055	J	1.030	0.057	J	1.030	0.057	U	4.361	5.121	J	1.030	0.057	J	0.992	0.253	UJ	0.062	0.168	=	1.050	0.136
IAAP84244	IAAP84244	pCi/g	UJ	-0.022	0.139	UJ	0.001	0.051	=	0.195	0.018	UJ	-0.019	0.503	=	16.300	0.157	=	1.237	0.047	J	0.949	0.047	J	0.949	0.047	UJ	0.654	4.728	J	0.949	0.047	=	1.115	0.258	U	0.000	0.171	J	0.613	0.138
IAAP84245	IAAP84245	pCi/g	UJ	0.043	0.149	U	0.037	0.053	=	0.453	0.022	UJ	-0.199	0.594	=	16.400	0.150	=	1.210	0.048	J	0.979	0.049	J	0.979	0.049	U	3.136	4.822	J	0.979	0.049	J	1.328	0.409	UJ	-0.021	0.423	J	1.272	0.342
IAAP84248	IAAP84248	pCi/g	UJ	-0.023	0.145	UJ	0.006	0.050	=	0.036	0.023	UJ	0.205	0.559	=	12.340	0.155	=	1.135	0.051	J	0.799	0.048	J	0.799	0.048	U	3.930	4.845	J	0.799	0.048	J	0.966	0.464	UJ	0.072	0.480	J	1.135	0.388
IAAP84249	IAAP84249	pCi/g	UJ	-0.085	0.334	UJ	-0.043	0.115	UJ	-0.007	0.057	UJ	-0.788	1.543	=	16.430	0.458	=	1.455	0.150	=	1.309	0.125	=	1.309	0.125	UJ	-3.041	11.030	=	1.309	0.125	J	1.410	0.434	UJ	0.089	0.242	=	1.584	0.195
IAAP84250	IAAP84250	pCi/g	UJ	-0.023	0.234	UJ	-0.036	0.066	UJ	-0.013	0.032	UJ	-0.152	0.857	=	14.170	0.253	J	0.960	0.076	J	1.009	0.091	J	1.009	0.091	UJ	1.313	6.788	J	1.009	0.091	J	0.841	0.120	UJ	0.041	0.275	J	0.485	0.119
IAAP84251	IAAP84251	pCi/g	UJ	0.069	0.157	UJ	-0.003	0.050	=	0.191	0.023	UJ	0.319	0.681	=	12.160	0.181	=	1.242	0.063	J	0.734	0.055	J	0.734	0.055	UJ	-0.077	4.723	J	0.734	0.055	J	0.778	0.141	UJ	0.176	0.322	J	0.865	0.260
IAAP84252	IAAP84252	pCi/g	UJ	0.183	0.770	UJ	0.027	0.164	=	226.200	0.094	UJ	-0.605	4.201	=	12.130	0.208	J	0.908	0.119	=	0.919	0.092	J	0.919	0.092	UJ	-0.920	14.750	J	0.919	0.092	J	0.426	0.245	UJ	-0.015	0.302	=	0.969	0.131

*This value was generated without full sample preparation and contains moisture variable.

ATTACHMENT C

BUILDING SURVEY DATA

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP DEMO DEACTIVATION FURNACE**		HSWP: S-04.001.0	Page 1 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1422

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): __F__ *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☐ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸**				**Field Bkgd (cpm) Beta (βγ)❹**				**Contamination Limits ($dpm/100cm^2$)**	
Eff. Count (cpm)	439 / 476	Initial		Final *(if needed)*		Initial		Final *(if needed)*			
Decayed dpm	3103	Count 1	0	Count 4		Count 1	202	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	0	Count 5		Count 2	203	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4683 / 4316	Count 3	0	Count 6		Count 3	194	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	0	6 Ave		Average	200	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	**Alpha (α) Limit**	**Alpha (α) Inv. Level**	**Beta (βγ) Limit**	**Beta (βγ) Inv. Level**
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	29	24	708	607

REMARKS:

❶ 10 minute BKGD counts, or ____min. Efficiency determined at calibration.
❷ 1 min source count, or ____min.
❸ 1 minute BKGD counts, or ____min.
❹ 1 minute BKGD counts, or ____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 ____ /

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP DEMO DEACTIVATION FURNACE**	HSWP: S-04.001.0	Page 2 of 6
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1422

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0	200	15.7	27.1
☐ Ludlum 2360/43-89	125								
☐ Micro-R ___	N/A								

Contamination Limits: (dpm/100cm²) — Removable α 60; Removable βγ 600; Total α 600; Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
1	Back Stairs	0	0	<60	44	1	<600	11	11	224	290	90	531	NA
2	On concrete in front of side building	1	1	<60	50	7	<600	70	70	1427	475	275	1624	NA
3	On concrete in front of side building	0	0	<60	45	2	<600	58	58	1182	411	211	1246	NA
4	concrete	0	0	<60	42	0	<600	52	52	1060	384	184	1086	NA
5	Concrete pad	0	0	<60	41	0	<600	95	95	1936	429	229	1352	NA
6	Concrete in front of stairs	0	0	<60	41	0	<600	144	144	2935	574	374	2208	NA
7	To the right of stairs on concrete	0	0	<60	37	0	<600	96	96	1957	450	250	1476	NA
8	concrete	0	0	<60	34	0	<600	19	19	387	330	130	768	NA
9	concrete	0	0	<60	49	6	<600	13	13	265	351	151	892	NA
10	Concrete pad	1	1	<60	28	0	<600	39	39	795	350	150	886	NA

REMARKS: All beta scan results were less than the investigation level. However, fixed point alpha measurements were greater than expected. Therefore additional fixed point investigation surveys were performed. Several areas exceeded the fixed alpha contamination limits. An attempt to determine if radon was the cause of the increased counts was conducted by placing plastic over a sampling point and resurveying that location 24 hours later. The final result (sample 21) was 30% less than the original value, but still over the fixed alpha limit. Although radon may have added to the activity, it can not be determined that radon accounts for all of the activity.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT (Supplement)

SURVEY LOCATION: **IAAAP DEMO DEACTIVATION FURNACE** — Page 3 of 6

Contamination Limits: (dpm/100cm²) Removable α 60 | Removable βγ 600 | Total α 600 | Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
11	Inside building on control box	0	0	<60	35	0	<600	1	1	<MDC	163	0	<MDC	NA
12	Inside building on back wall	0	0	<60	35	0	<600	0	0	<MDC	283	83	490	NA
13	Inside building on floor near side door	0	0	<60	35	0	<600	0	0	<MDC	219	19	<MDC	NA
14	Concrete pad near deactivation furnace	0	0	<60	44	1	<600	11	11	224	284	84	496	NA
15	Edge of concrete pad near furnace	1	1	<60	43	0	<600	36	36	734	326	126	744	NA
16	On concrete pad near furnace	0	0	<60	46	3	<600	16	16	326	280	80	472	NA
17	Bottom of concrete pad under furnace	0	0	<60	33	0	<600	6	6	122	290	90	531	NA
18	Concrete pad near stairs by furnace	0	0	<60	53	10	<600	19	19	387	308	108	638	NA
19	Concrete pad	1	1	<60	37	0	<600	28	28	571	284	84	496	NA
20	Concrete pad in front of furnace	0	0	<60	43	0	<600	31	31	632	349	149	880	NA
21	Recheck of #6 after 24 hours	NA	NA	NA	NA	NA	NA	100	100	2038	500	300	1771	NA

REMARKS: 43-10-1 MDA for alpha is 13dpm and for beta 67 dpm.
21.This spot was covered in plastic and left in place for 24 hours then the plastic was removed and a fixed point was retaken.
43-89 MDA for alpha is 61 dpm/100cm² and for beta is 406 dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

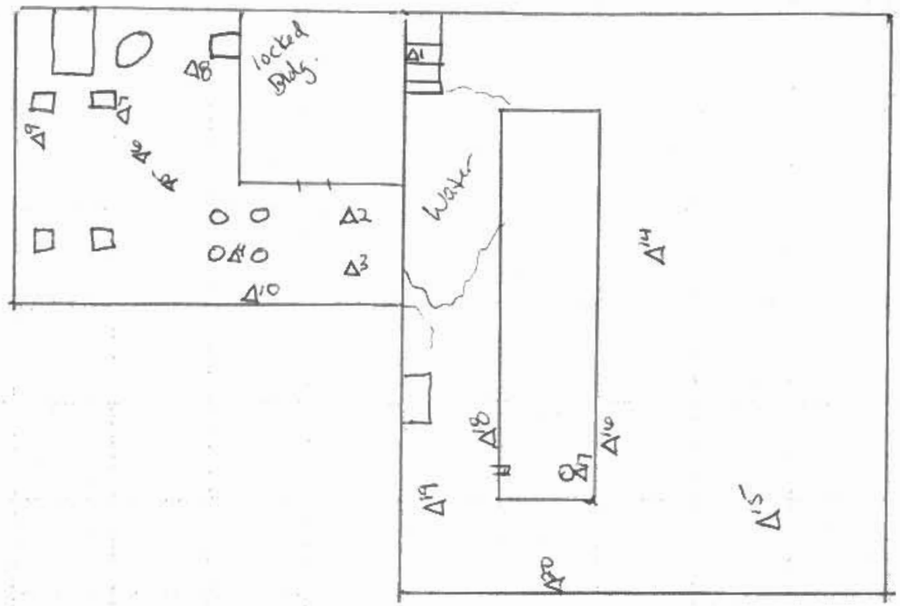
SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: Deactivation furnace | Page 4 of 6

Legend: (Fill in blank) ______ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.

outside concrete pads w/misc. structures.



REMARKS: Biased beta scan surveys were performed in areas w/the highest potential for contamination in accordance w/section 4.3.2.2 of the survey plan.
Scan Range: 150 - 600cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

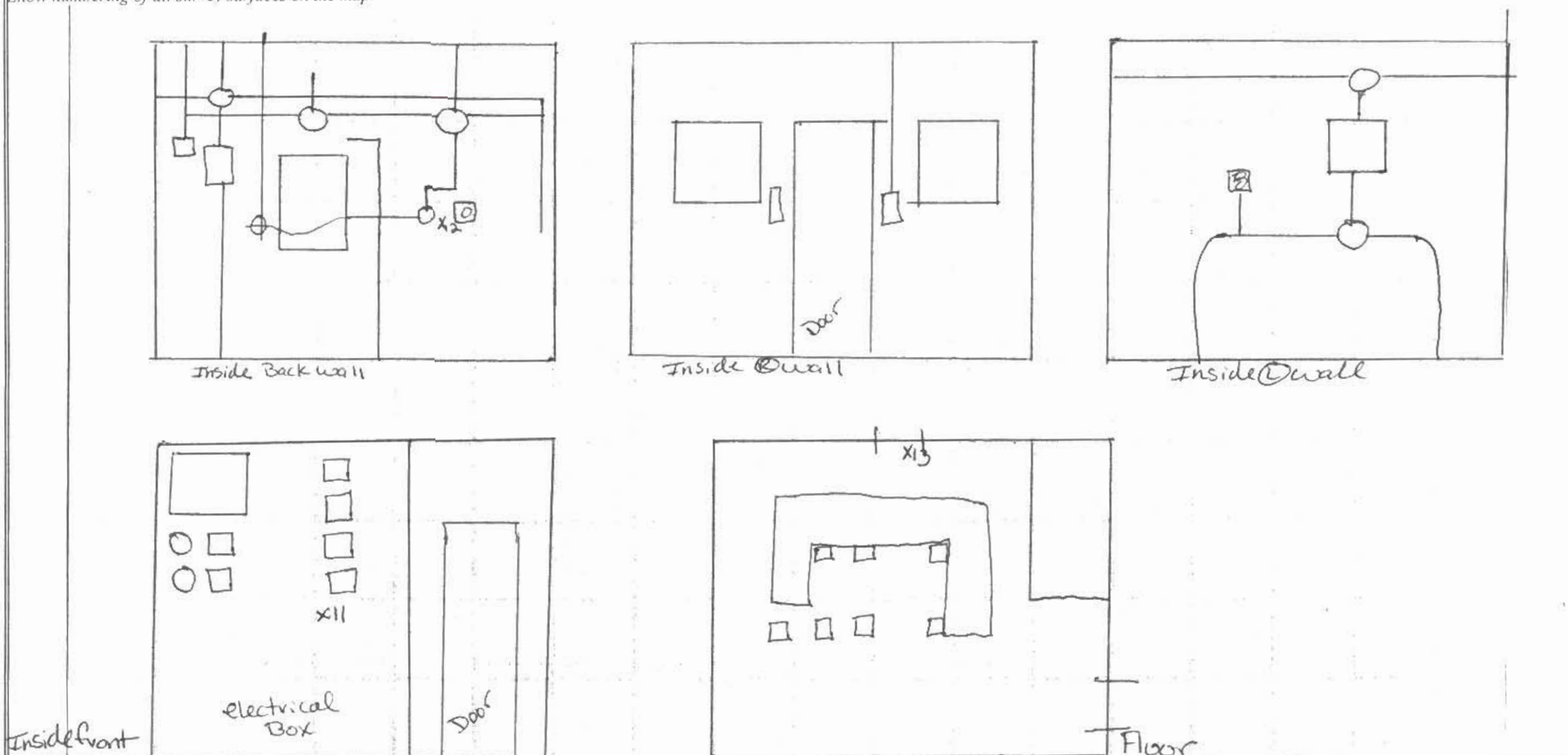
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: Deactivation furnace inside of Building | Page 5 of 6

Legend: (Fill in blank) _______ = Smear Location _______ = G/A Dose Rate ☐ mR/hr ☐ µR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Biased beta scan Surveys were performed in areas w/the highest potential for contamination in accordence to section 4.3.2.2 of the Survey Plan
Scan Range 150 – 300cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

60le

Survey Number:		Date:	8/18/2004	Inst. Letter:	F

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **61.1** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **406** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b * \left(\frac{i}{60}\right)} * \left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	$i = 3.0$ $MDCR = 87$ Beta Scan *MDC* = **724** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	0	(cpm)	Background count rate (R_b) or (b)	200	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-1**		HSWP: S-04.001.0	Page 1 of 7
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1138

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): ___B____ (*for this survey*)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final (*if needed*)		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final (*if needed*)		**Contamination Limits ($dpm/100cm^2$)**	
Eff. Count (cpm)	~~477~~ 439 / ~~4??~~ 476										
Decayed dpm	3130	Count 1	0	Count 4		Count 1	310	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	1	Count 5		Count 2	332	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4683 / 4316	Count 3	0	Count 6		Count 3	343	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	.3	6 Ave		Average	328	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	30	24	836	735

REMARKS:

❶ 10 minute BKGD counts, or _____min.
❷ 1 min source count. or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 [signature] / 8-24-04

REVIEWER SIGNATURE/DATE: [signature] / 11/5/04

Version 1.3 9/25/

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-1**	HSWP: S-04.001.0		Page 2 of 7
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1138

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	Before→	0.4	222	14.4	26.0
☐ Other						After→	1.2	205	14.4	26.0

Instrument Letter (A-H): ___D_______ *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final *(if needed)*		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	472 / 446										
Decayed dpm	3103	Count 1	1	Count 4		Count 1	333	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	7	Count 5		Count 2	332	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4127 / 3945	Count 3	4	Count 6		Count 3	326	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	4*	6 Ave		Average	330	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	31	26	818	720

REMARKS: *Field background alpha counts were higher than expected. This is likely due to increased radon.

❶ 10 minute BKGD counts, or _____min.
❷ 1 min source count, or ____ min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-1**	HSWP: S-04.001.0	
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1138

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency (%) Alpha (α)	Efficiency (%) Beta (βγ)
☒ Ludlum 2929/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.3	328	15.7	27.1
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	4 (0.4)*	330	14.4	26.0
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60 Removable βγ 600 Total α 600 Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
1	Drain in back room of basement	0	0	<60	46	3	<600	8	8	163	396	68	<MDC	NA
2	Drain in main room of basement	1	1	<60	47	4	<600	6	6	122	397	69	<MDC	NA
3	Sink	0	0	<60	49	6	<600	4	4	<MDC	550	222	1310	NA
4	Wall in backroom near door	0	0	<60	45	2	<600	1	1	<MDC	467	139	821	NA
5	Bottom of stairs	0	0	<60	43	0	<600	8	8	163	400	72	<MDC	NA
6	Brick wall in SE corner Upstairs	0	0	<60	43	0	<600	10	10*	<MDC	486	156	960	NA
7	Doorway between rooms upstairs	0	0	<60	49	6	<600	6	6*	<MDC	398	68	<MDC	NA
8	Floor drain back room upstairs	0	0	<60	56	13	<600	4	4*	<MDC	381	51	<MDC	NA
9	Back room front of door upstairs	0	0	<60	53	10	<600	2	2*	<MDC	365	35	<MDC	NA
10	Main room drain upstairs	0	0	<60	59	16	<600	2	2*	<MDC	425	95	585	NA

REMARKS: Sample nos. 1 thru 5 are from instrument Q for the direct readings and Sample nos. 6 thru 10 are from the other 43-89 listed for the direct readings. *Since alpha field background for samples 6 thru 10 may have been skewed high due to radon, the initial daily alpha background check-in value (0.4) was used to conservatively calculate total alpha activity. 43-10-1 MDA: 13dpm for alpha, 67 dpm for beta. 43-89 Q MDA for alpha is 113 dpm/100cm2 and for beta is 515dpm/100cm². The other 43-89 MDA for alpha is 274 dpm/100cm² and for beta is 539dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/24/04 /

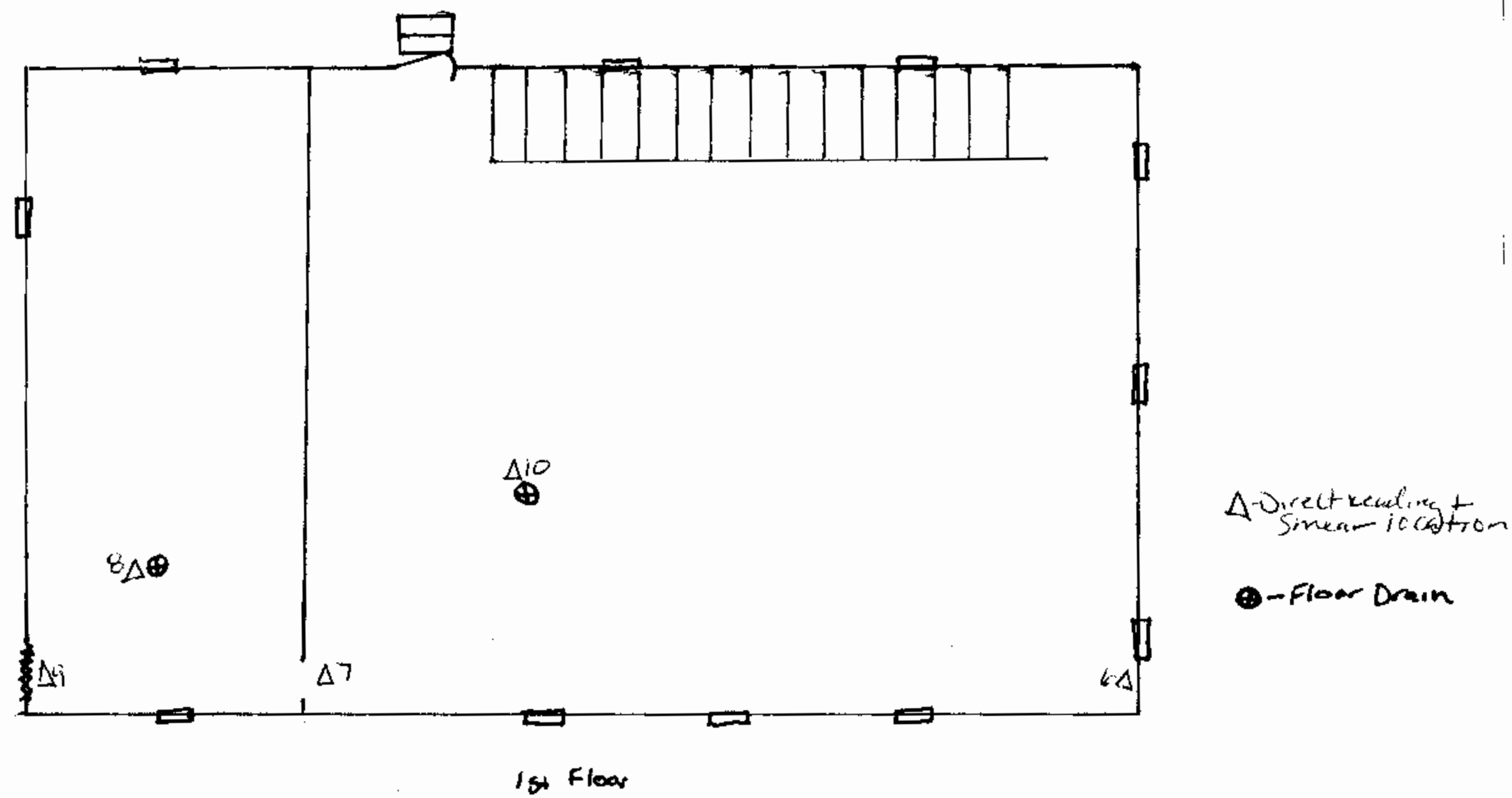
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: IAAAP 6DA BG-1 1st Floor

Legend: (Fill in blank) Δ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Biased beta scan surveys were performed in areas with the highest potential for contamination in accordance with Section 4.3.2.2 of the Scoping Survey Plan.
Concrete Scans: 250-450 cpm (Beta)
Brick Scans: 350-600 cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 [signature] / 8-24-04

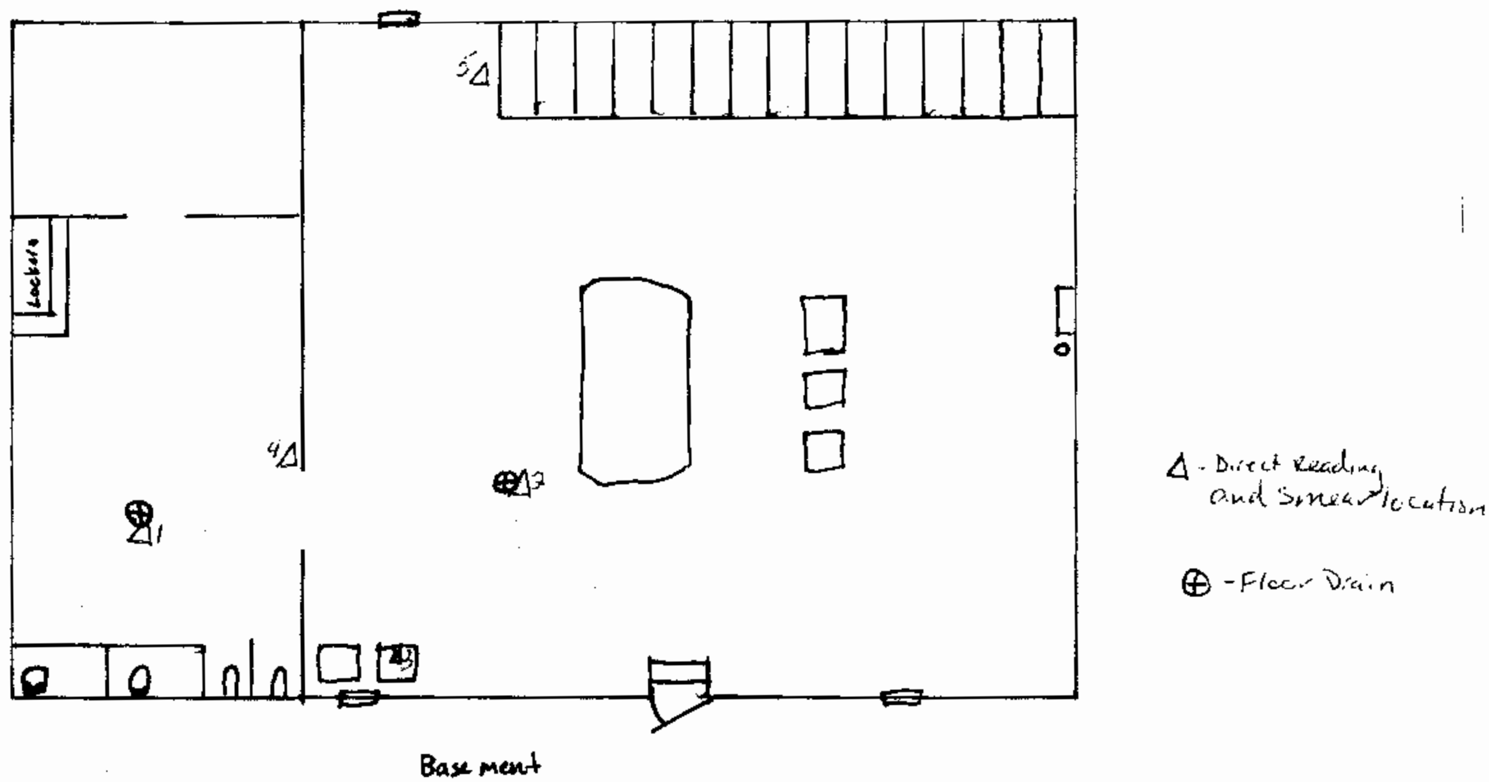
REVIEWER SIGNATURE/DATE: [signature] / 11/5/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: IAAAP EDA BG-1 ~~Up stairs~~ base ment — Page 5 of 7

Legend: (Fill in blank) Δ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Biased Beta Scan Surveys were performed in areas with the highest potential for contamination in accordance with Section 4.3.2.2 of the Scoping Survey Plan.
Concrete Scans: 250-450 cpm (Beta)
Brick Scans: 350-600 cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 [signature] / 8-24-04

REVIEWER SIGNATURE/DATE: [signature] / 11/5/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

6 of 7

Survey Number:	Date: 8/18/2004	Inst. Letter: B

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **515** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 111 Beta Scan *MDC* = **927** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	0.3	(cpm)	Background count rate (R_b) or (b)	328	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

787

Survey Number:	Date: 8/18/2004	Inst. Letter: D

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **273.5** (dpm/100cm^2)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **539** (dpm/100cm^2)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.97** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 111 Beta Scan MDC = **969** (dpm/100cm^2)

Alpha Information			Beta Information		
Background count rate (R_b)	4	(cpm)	Background count rate (R_b) or (b)	330	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.144	(cpm/dpm)	Instrument efficiency (e_i)	0.26	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm^2)	Probe area (PA)	125	(cm^2)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm^2)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BUNKER**		HSWP: S-04.001.0	Page 1 of 4
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/18/04	Time: 1302

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.5	185	15.7	27.1
☐ Other ______	______					After→	0.5	247	15.7	27.1

Instrument Letter (A-H): ___A___ (*for this survey*)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final (*if needed*)		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final (*if needed*)		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	484 / 529										
Decayed dpm	3103	Count 1	0	Count 4		Count 1	213	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	1	Count 5		Count 2	211	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4564 / 4513	Count 3	0	Count 6		Count 3	211	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	.3	6 Ave		Average	212	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	24	19	720	619

REMARKS:

❶ 10 minute BKGD counts, or _____min. Efficiency determined at calibration.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/18/04 ______ /

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

4024

Survey Number:	Date: 8/18/2004	Inst. Letter: F

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm^2)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **418** (dpm/100cm^2)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 89 Beta Scan *MDC* = **745** (dpm/100cm^2)

Alpha Information			Beta Information		
Background count rate (R_b)	0.3	(cpm)	Background count rate (R_b) or (b)	212	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm^2)	Probe area (PA)	125	(cm^2)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm^2)	-----	-----	-----

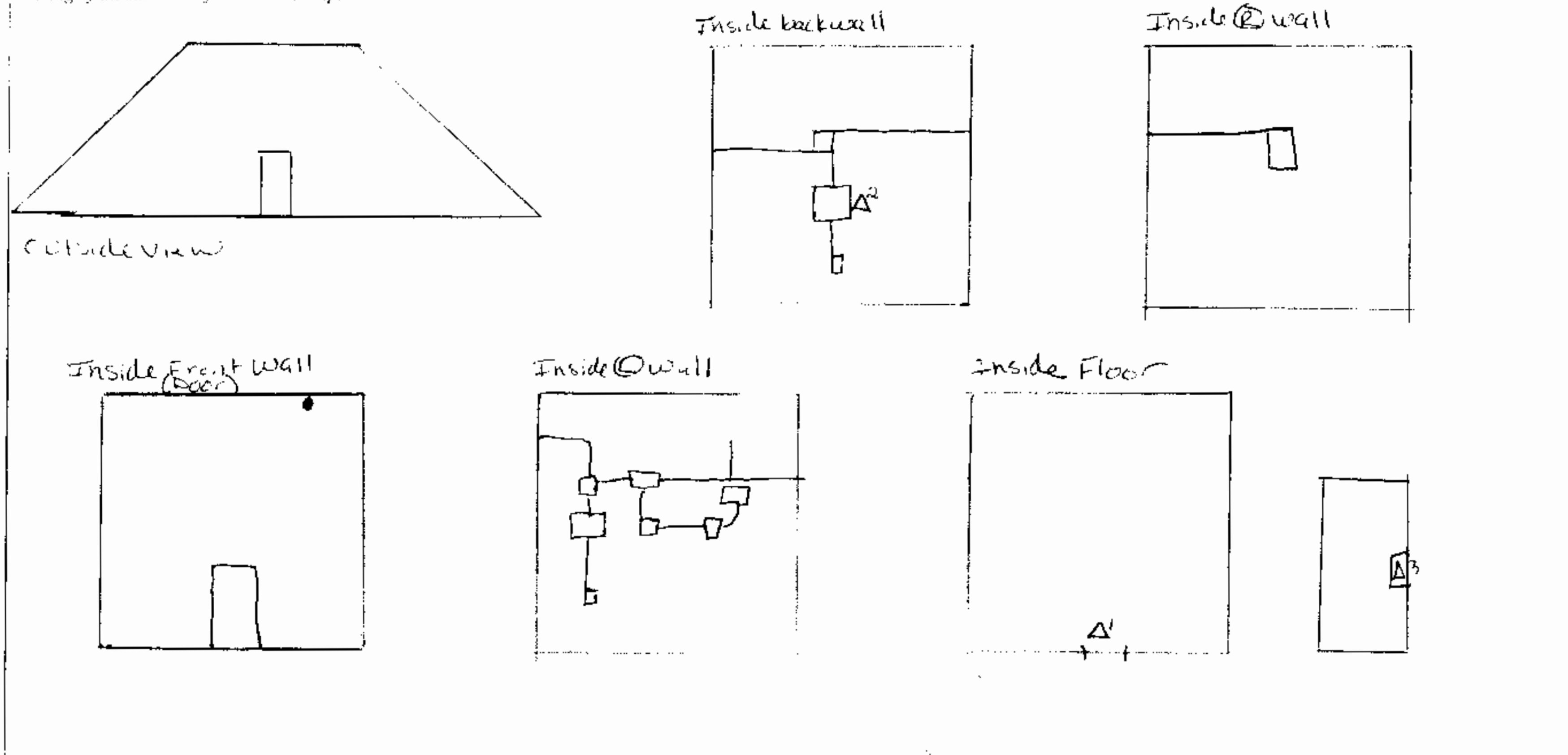
1 in/sec = 2.5 cm/sec   2 in/sec = 5.1 cm/sec   3 in/sec = 7.6 cm/sec   :   The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: IAAAP EDA Bunker | Page 3 of 4

Legend: (Fill in blank) ______ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ µR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Biased beta Scan Surveys were performed in areas w/the highest potential for contamination in accordance w/section 4.3.2.2. of the Survey Plan.
Scan Range: 100 - 400cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/18/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BUNKER**	HSWP: S-04.001.0	Page 2 of 4
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/18/04	TIME: 1302

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.3	212	15.7	27.1
☐ Ludlum 2221/44-9	15.5								
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60; Removable βγ 600; Total α 600; Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
1	Floor	0	0	<60	42	0	<600	2	2	<MDC	286	74	434	NA
2	Inside wall	0	0	<60	42	0	<600	1	1	<MDC	238	26	<MDC	NA
3	Inside Door Push Plate	0	0	<60	44	1	<600	8	8	163	188	0	<MDC	NA

REMARKS: 43-10-1 MDA for alpha is 13 dpm and for beta is 67 dpm. 43-89 MDA for alpha is 113 dpm/100cm² and for beta is 418 dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/18/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP DEMO 900-189-1**		HSWP: S-04.001.0	Page 1 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/25/04	Time: 1030

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☑ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.5	211	15.7	27.1
☐ Other ______	______					After→	0.5	214	15.7	27.1

Instrument Letter (A-H): ___H_______
(for this survey)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final *(if needed)*		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	516 / 453										
Decayed dpm	3163	Count 1	0	Count 4		Count 1	278	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	0	Count 5		Count 2	262	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4454 / 4490	Count 3	1	Count 6		Count 3	237	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	.3	6 Ave		Average	259	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	30	24	767	666

REMARKS:

❶ 10 minute BKGD counts, or _____min. Efficiency determined at calibration.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/25/04 [signature] / 8-25-04

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP DEMO 900-189-1**	HSWP: S-04.001.0	Page 2 of 6
Purpose Of Survey: Scoping Survey / Survey Number:	Date: 8/25/04	Time: 1030

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89	125	145477	1648116	06/15/05	06/15/05	Before→	0.7	208	14.4	26.0
☐ Other ___	___					After→	1.0	206	14.4	26.0

Instrument Letter (A-H): ___I_______ *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☐ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final *(if needed)*		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	500 / 4K9										
Decayed dpm	3163	Count 1	1	Count 4		Count 1	260	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	0	Count 5		Count 2	242	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4444 / 4470	Count 3	1	Count 6		Count 3	255	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15609	Average	.7	6 Ave		Average	252	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	28	22	740	642

REMARKS:

❶ 10 minute BKGD counts, or _____min. Efficiency determined at calibration. This instrument was used for QC purposes.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/25/04 [signature] / 8-25-04

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP DEMO 900-189-1** | HSWP: S-04.001.0 | Page 3 of 6

PURPOSE OF SURVEY: Scoping Survey | DATE: 8/25/04 | TIME: 1030

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency (%) Alpha (α)	Efficiency (%) Beta (βγ)
☒ Ludlum 2221/43 10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.3	259	15.7	27.1
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	0.7	252	14.4	26.0
☐ Micro-R ___	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60; Removable βγ 600; Total α 600; Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
1	Floor concrete by door	1	1	<60	47	4	<600	1	1	<MDC	260	1	<MDC	NA
2	Floor concrete by door with phone	2	2	<60	54	11	<600	0	0	<MDC	242	0	<MDC	NA
3	Wall by phone	0	0	<60	63	20	<600	1	1	<MDC	255	0	<MDC	NA
4	QC of Floor concrete by door	0	0	<60	50	7	<600	4	4	<MDC	358	106	652	NA
5	QC of Floor concrete by door with phone	0	0	<60	52	9	<600	6	6	<MDC	351	99	609	NA

REMARKS: 43-10-1 MDA for alpha is 13 dpm and for beta is 67 dpm. QC instrument is the 43-89 without a letter assigned to it. 43-89Q MDA for alpha is 113 dpm/100cm² and for beta is 460 dpm/100cm². 43-89 MDA for alpha is 141 dpm/100cm² and for beta is 454 dpm/100cm². QC samples meet the data quality objectives.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/25/04 /

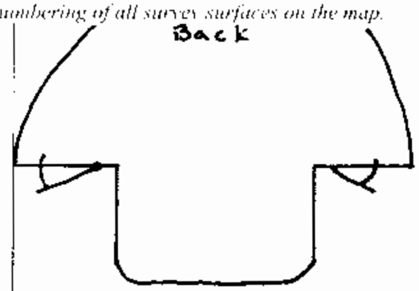
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

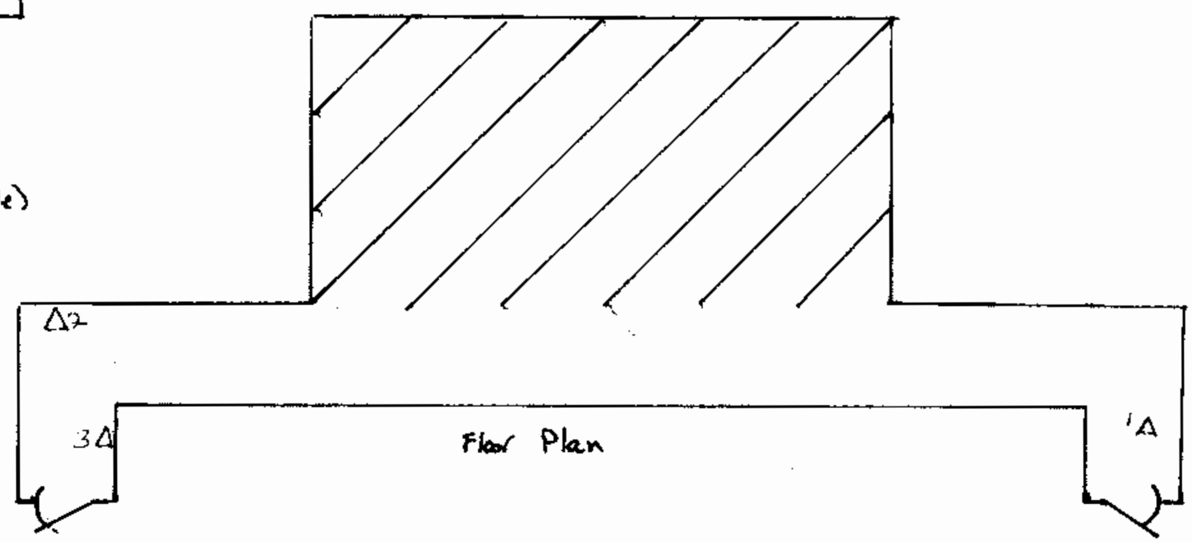
Survey Number: IAAAP Demolition area 900-189-1 | Page 4 of 6

Legend: (Fill in blank) Δ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ µR/hr

Show numbering of all survey surfaces on the map.



Raining during survey of the bunker, concrete was damp.



Δ-Direct Reading and Smear location

REMARKS: ▨ Area not surveyed Biased Beta Scan Surveys were performed in areas w/ the highest potential for contamination in accordance w/ Section 4.3.2.2 of the Survey Plan.
Scan Range: 200-350 cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/25/04 [signature] / 8-25-04

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

Version 1.3 9/25/2003

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

59.6

Survey Number:	Date: 8/18/2004	Inst. Letter: H

Alpha		Beta	
$Static\ MDC = \dfrac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm²)	$Static\ MDC = \dfrac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **460** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \dfrac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 99 Beta Scan *MDC* = **824** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	0.3	(cpm)	Background count rate (R_b) or (b)	259	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec   2 in/sec = 5.1 cm/sec   3 in/sec – 7.6 cm/sec   :   The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

leb.le

Survey Number:	Date: 8/18/2004	Inst. Letter: 1

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha $Static\ MDC$ = **140.5** (dpm/100cm^2)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta $Static\ MDC$ = **454** (dpm/100cm^2)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i – 3.0 $MDCR$ – 97 Beta Scan MDC = **813** (dpm/100cm^2)

Alpha Information			Beta Information		
Background count rate (R_b)	0.7	(cpm)	Background count rate (R_b) or (b)	252	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm^2)	Probe area (PA)	125	(cm^2)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm^2)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-5**	HSWP: S-04.001.0	Page 1 of 4

Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1040

Instrument Type(s): (√ if used)	**Detector Area (cm^2)**	**Serial Number:**		**Cal. Due Date:**			**Lab Bkgd: (CPM)❶**		**Lab Efficiency (0.00)❷**	
		meter	**detector**	**meter**	**detector**		**Alpha (α)**	**Beta (βγ)**	**Alpha (α)**	**Beta (βγ)**
☐ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	Before→	0.4	222	14.4	26.0
☐ Other ______						After→	1.2	205	14.4	26.0

Instrument Letter (A-H): E
(for this survey)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☐ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SHL0007		**Field Bkgd (cpm) Alpha (α)❸**				**Field Bkgd (cpm) Beta (βγ)❹**				**Contamination Limits ($dpm/100cm^2$)**	
Eff. Count (cpm)	472 / 446	Initial		Final *(if needed)*		Initial		Final *(if needed)*			
Decayed dpm	3163	Count 1	5	Count 4		Count 1	220	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SHL0006		Count 2	2	Count 5		Count 2	277	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4122 / 3946	Count 3	7	Count 6		Count 3	248	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15309	Average	4.7	6 Ave		Average	248	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	**Alpha (α) Limit**	**Alpha (α) Inv. Level**	**Beta (βγ) Limit**	**Beta (βγ) Inv. Level**
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	32	26	736	638

REMARKS: Field background alpha counts were higher than expected. This is likely due to increased radon.

❶ 10 minute BKGD counts, or ____min. Efficiency determined at calibration.
❷ 1 min source count, or ____ min.
❸ 1 minute BKGD counts, or ____min.
❹ 1 minute BKGD counts, or ____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-5** | HSWP: S-04.001.0 |

PURPOSE OF SURVEY: Scoping Survey | DATE: 8/24/04 | TIME: 1040

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	4.7(0.4)*	248	14.4	26.0
☐ Ludlum 2221/44-9	15.5								
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60; Removable βγ 600; Total α 600; Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
1	Floor of Door Threshold	0	0	<60	51	8	<600	24	24*	533	368	120	739	NA
2	Floor	0	0	<60	39	0	<600	1	1*	<MDC	305	57	<MDC	NA
3	Inside back wall	0	0	<60	41	0	<600	8	8*	<MDC	315	67	<MDC	NA

REMARKS:
Floor was covered with dirt. *Since alpha field background may have been higher due to radon, the initial daily alpha background checkin value (0.4) was used to conservatively calculate total alpha activity. 43-10-1 MDA for alpha is 13dpm and for beta is 67 dpm. 43-89 MDA for alpha is 291 dpm/100cm² and for beta 469 dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

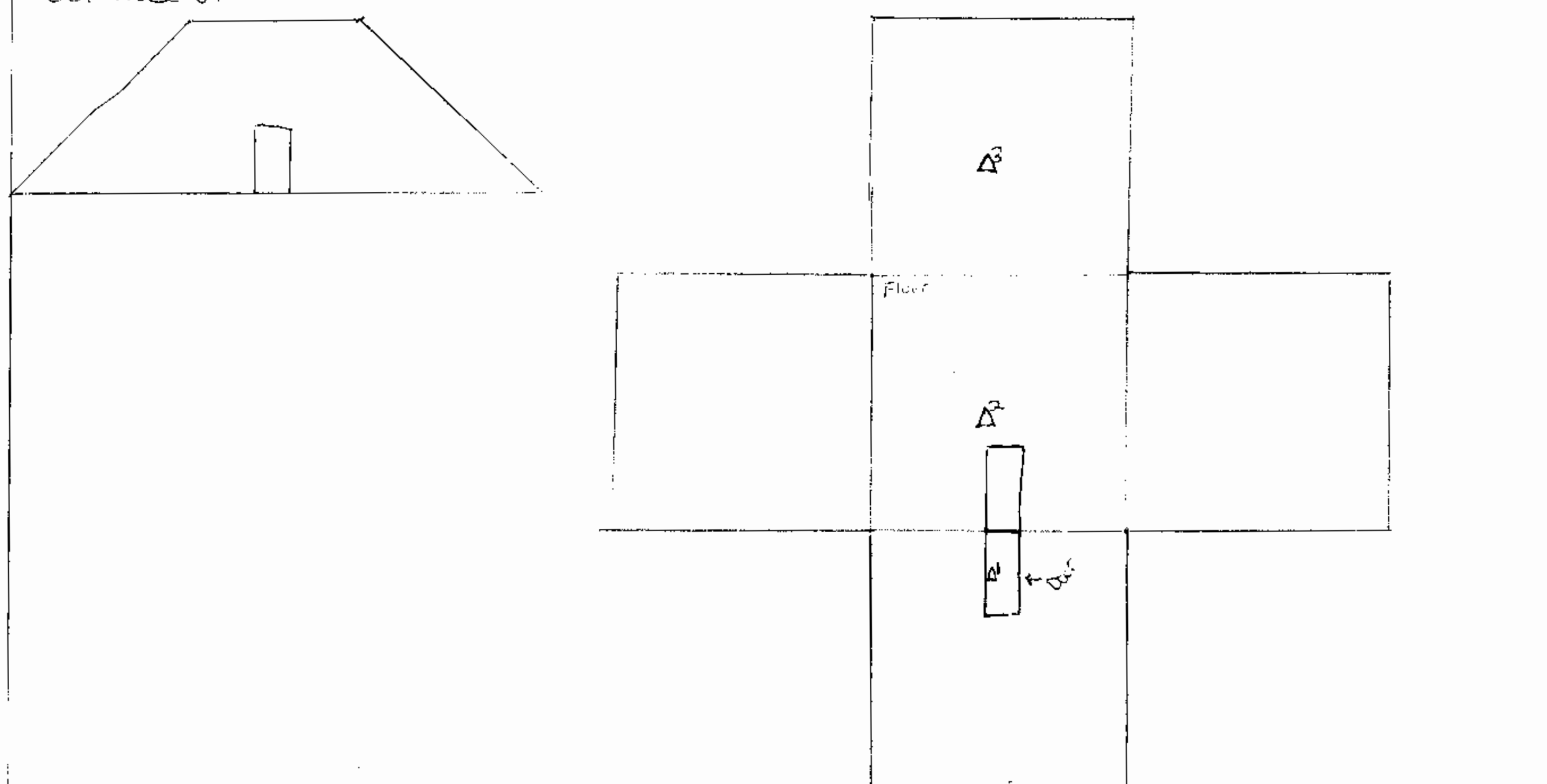
SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: BG-5 | Page 3 of 4

Legend: (Fill in blank) ______ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.

outside View



REMARKS: Biased beta scan surveys were performed in areas with the highest potential for contamination in accordance w/ section 4.3.2.2 of the SEP.ry Survey Plan.
Scan Ranges: 150-400cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

Survey Number:	Date: 8/18/2004	Inst. Letter: E

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **290.8** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **469** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.97** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 97 Beta Scan *MDC* = **840** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	4.7	(cpm)	Background count rate (R_b) or (b)	248	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.144	(cpm/dpm)	Instrument efficiency (e_i)	0.26	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec   2 in/sec = 5.1 cm/sec   3 in/sec = 7.6 cm/sec   :   The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-4**		HSWP: S-04.001.0	Page 1 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1100

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): G *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final *(if needed)*		**Contamination Limits ($dpm/100cm^2$)**	
Eff. Count (cpm)	472 / 4416										
Decayed dpm	3103	Count 1	0	Count 4		Count 1	229	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	0	Count 5		Count 2	206	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4122 / 3948	Count 3	1	Count 6		Count 3	190	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	.3	6 Ave		Average	208	6 Ave		Beta (βγ) Inv. Level	4800

a priori **Action Levels: (CPM)**	**Alpha (α) Limit**	**Alpha (α) Inv. Level**	**Beta (βγ) Limit**	**Beta (βγ) Inv. Level**
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	30	24	716	615

REMARKS:

❶ 10 minute BKGD counts, or _____ min. Efficiency determined at calibration.
❷ 1 min source count, or _____ min.
❸ 1 minute BKGD counts, or _____ min.
❹ 1 minute BKGD counts, or _____ min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 11/2/04 /

REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-4**		HSWP: S-04.001.0	Page 2 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1100

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	Before→	0.4	222	14.4	26.0
☐ Other ________	______					After→	1.2	205	14.4	26.0

Instrument Letter (A-H): J
(for this survey)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final *(if needed)*		**Contamination Limits (dpm/100cm^2)**	
Eff. Count (cpm)	472 / 446										
Decayed dpm	3103	Count 1	1	Count 4		Count 1	179	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	0	Count 5		Count 2	181	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4122 / 3946	Count 3	2	Count 6		Count 3	217	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	1	6 Ave		Average	192	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	**Alpha (α) Limit**	**Alpha (α) Inv. Level**	**Beta (βγ) Limit**	**Beta (βγ) Inv. Level**
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	28	23	680	582

REMARKS:
❶ 10 minute BKGD counts, or _____min. Efficiency determined at calibration. This meter was used for QC purposes.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____ min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 ______ /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-4**	HSWP: S-04.001.0	Page 3 of 6
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1100

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency (%) Alpha (α)	Efficiency (%) Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.6	208	15.7	27.1
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	6/15/05	1	192	14.4	26.0
☐ Micro-R ___	N/A								

Contamination Limits: (dpm/100cm²) Removable α **60** Removable βγ **600** Total α **600** Total βγ **6000**

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
1	Inside Left Wall	1	1	<60	39	0	<600	3	3	<MDC	249	41	<MDC	NA
2	Inside Right wall	0	0	<60	35	0	<600	2	2	<MDC	224	16	<MDC	NA
3	Inside Door	0	0	<60	43	0	<600	2	2	<MDC	179	0	<MDC	NA
4	QC of inside Left Wall	0	0	<60	43	0	<600	0	0	<MDC	235	43	<MDC	NA

REMARKS: 43-10-1 MDA for alpha is 13dpm and for beta is 67 dpm.
Scan range of the building was 150 to 300 on the concrete surfaces and 150 to 250 on the door. QC was taken with other the 43-89 not assigned a letter. MDA for 43-89 Q for alpha is 113dpm/100cm² and for beta is 414 dpm/100cm².
MDA for 43-89 for alpha is 170 dpm/100cm² and for beta is 415 dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

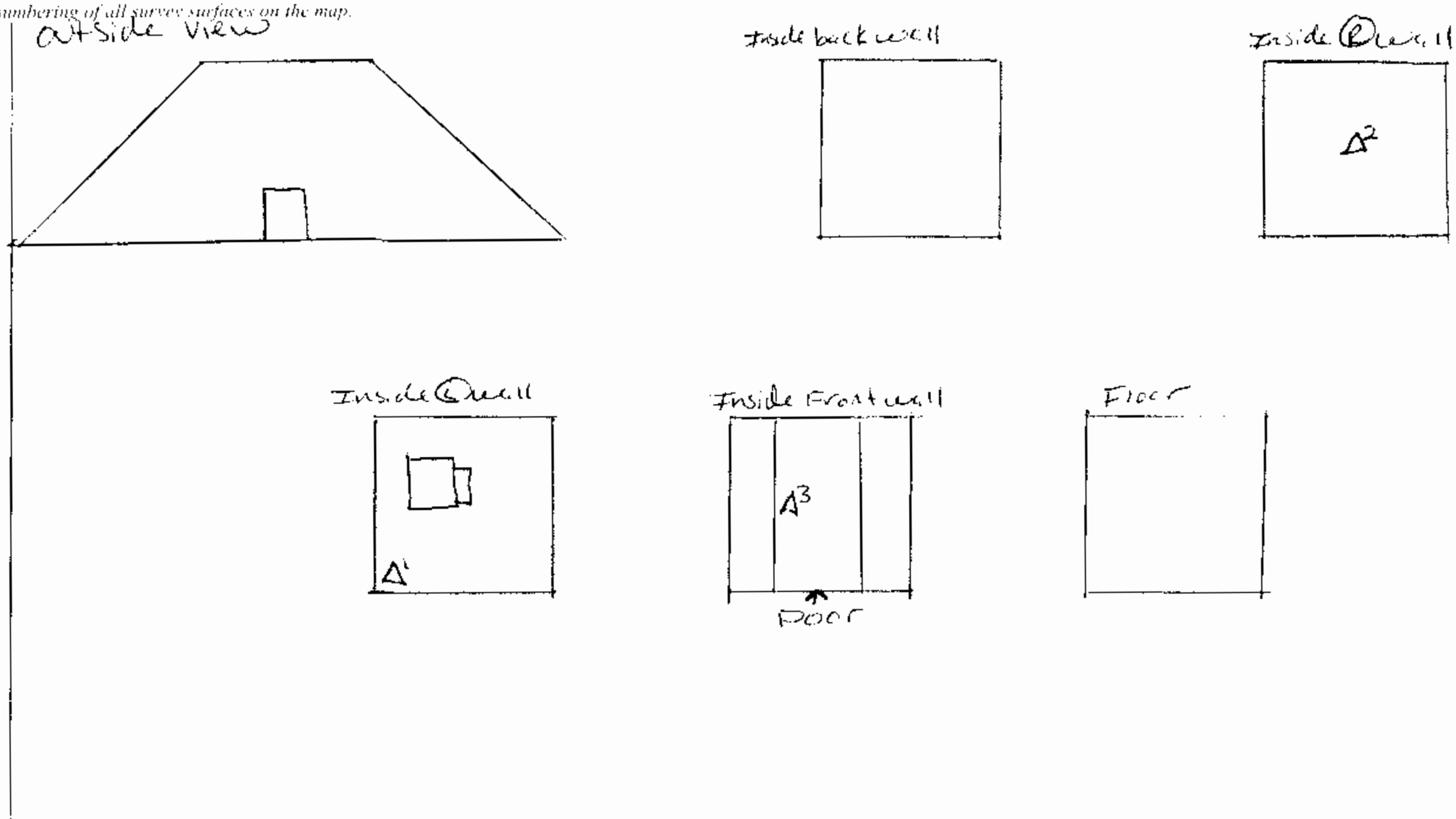
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: BG-4

Legend: (Fill in blank) ______ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ µR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Based Beta scan Surveys were performed in areas w/the highest potential for contamination in accordance with Section 4.3.2.2 of the Survey Plan.
Scans: 150-300cpm (Beta)
Door Scan: 150-250cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 5/24/04

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

5864

Survey Number:	Date: 8/18/2004	Inst. Letter: G

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **414** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 88 Beta Scan *MDC* = **738** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	0.3	(cpm)	Background count rate (R_b) or (b)	208	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec   2 in/sec = 5.1 cm/sec   3 in/sec = 7.6 cm/sec   :   The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

60f6

Survey Number:	Date: 8/18/2004	Inst. Letter: J

Alpha			Beta		
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **170.1** (dpm/100cm²)		$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **415** (dpm/100cm²)	
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.97** (should be ≥ 0.85)		$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 85 Beta Scan *MDC* = **739** (dpm/100cm²)	
Alpha Information			**Beta Information**		
Background count rate (R_b)	1	(cpm)	Background count rate (R_b) or (b)	192	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.144	(cpm/dpm)	Instrument efficiency (e_i)	0.26	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-3**		HSWP: S-04.001.0	Page 1 of 4
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1017

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): __ C____ (*for this survey*)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final (*if needed*)		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final (*if needed*)		**Contamination Limits ($dpm/100cm^2$)**	
Eff. Count (cpm)	439 / 476										
Decayed dpm	3103	Count 1	1	Count 4		Count 1	269	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC0006		Count 2	0	Count 5		Count 2	243	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4683 / 4316	Count 3	1	Count 6		Count 3	229	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	0.7	6 Ave		Average	247	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	30	24	755	654

REMARKS:

❶ 10 minute BKGD counts, or _____min. Efficiency was determined at calibration.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 ______ /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-3**	HSWP: S-04.001.0	Page 2 of 4
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1017

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency (%) Alpha (α)	Efficiency (%) Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.7	247	15.7	27.1
☐ Ludlum 2221/44-9	15.5								
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60; Removable βγ 600; Total α 600; Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
1	Inside Left Wall	0	0	<60	45	2	<600	5	5	<MDC	330	83	490	NA
2	Inside Right Wall	2	2	<60	45	2	<600	1	1	<MDC	323	76	<MDC	NA
3	Front Right inside Door	0	0	<60	44	1	<600	3	3	<MDC	203	0	<MDC	NA

REMARKS: 43-10-1 MDA for alpha is 13 dpm and for beta is 67 dpm. 43-89 MDA for alpha is 141 dpm/100cm² and for beta is 449 dpm/100cm². Concrete scans: 250-350 cpm (beta). Steel scans: 150-250 cpm (beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

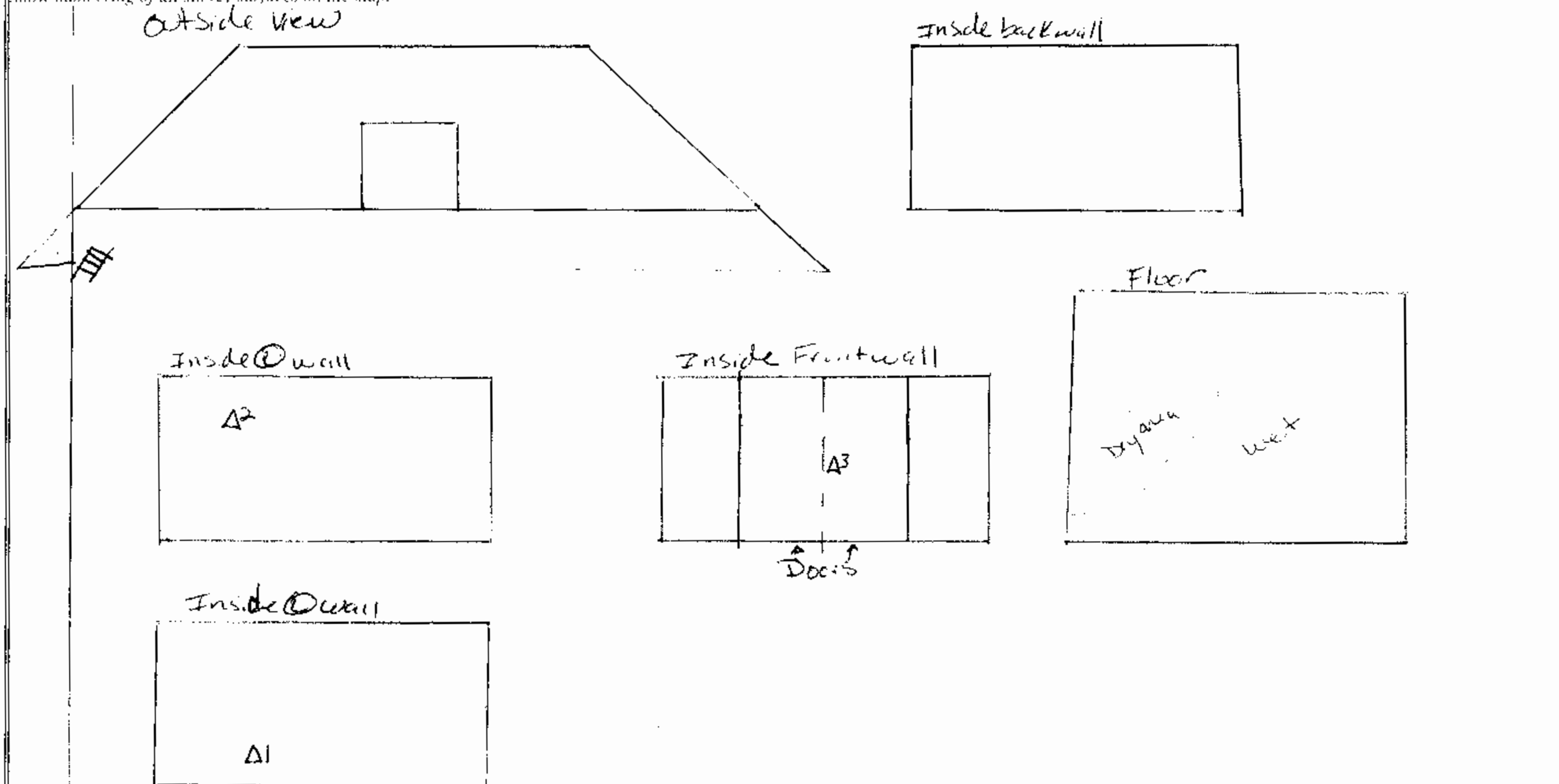
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: 3G-3

Legend: (Fill in blank) Δ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Based beta scan surveys were performed in areas with the highest ~~[illegible]~~ potential for contamination in accordance w/ section 4.3.2.2 of the Survey Plan.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

Survey Number:	Date: 8/18/2004	Inst. Letter: C

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **140.5** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **449** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	$i = 3.0$ $MDCR = 96$ Beta Scan *MDC* = **805** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	0.7	(cpm)	Background count rate (R_b) or (b)	247	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm