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GENERAL RADIOACTIVE MATERIAL SURVEY PLAN RADIOLOGICAL SURVEYS CONDUCTED TO SUPPORT CLOSURE OF FACILITIES MILLINGTON SUPPACT TN
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U S NAVY

General Radioactive Material (G-RAM) Survey Plan: Radiological Surveys Conducted to Support Closure of Facilities at Naval Support Activity Memphis, TN

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January 30,1998

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SECTION 1

INTRODUCTION

SECTION 1
INTRODUCTION

A. General History and Information

Naval Support Activity - Memphis (NSA) is a large naval facility located in Millington, Tennessee. The Congress of the United States passed an act in 1917 to accept a plot of land east of Millington, Tennessee to create an air field. This site was operated as an Army Aviation Field known as Park Field from 1917 until 1939. In 1939 it was chosen as a permanent Naval Air Reserve Base and commissioned in 1942. The facility was also home of the Naval Air Technical Training Center that served as the primary aviation training base and technical training location for the Navy. In 1943 the Base was reassigned as a Naval Air Station. The 1993 Base Realignment and Closure Act reassigned the facility as Naval Support Activity - Memphis.

Located approximately sixteen miles from Memphis, TN in Shelby County, Naval Support Activity - Memphis consist of two major areas: an air field to the north of Navy Road, and support facilities and housing south of Navy Road. The entire site consist of more than 3,450 acres of land. Most of the land surrounding the site is farmland and woodland. Some commercial property borders the Base on its far western boundary just north of Navy Road. A major tenant command to Naval Air Station - Memphis was the Naval Hospital Millington which was commissioned in 1943. Another tenant included the Defense Reutilization and Marketing Office (DRMO) Salvage Yard operated by the Defense Logistics Agency.

B. Navy Department Radiation Protection Program Organization

The Secretary of the Navy assigned to the Chief of Naval Operations (CNO) the responsibility to establish and manage the Navy Safety and Occupational Safety and Health Program. The CNO assigned to the Naval Sea Systems Command specific program responsibilities pertaining to ionizing radiation.

There are four main naval programs that maintain responsibility for radioactive materials, depending on their use; they are the Bureau of Medicine and Surgery (BUMED), the Nuclear Weapons Radiological Controls Program (NWRCP), the

Naval Nuclear Propulsion Program (NNPP) and the Radiological Affairs Support Program (RASP), the latter which is significant to NSA Memphis, TN.

- The RASP provides radiation safety guidance for ionizing radiation sources, such as, radioactive material licensed by the Nuclear Regulatory Commission (NRC), naturally-occurring and accelerator-produced radioactive material (NARM), and machine sources such as x-ray machines, particle accelerators, electron microscopes, laboratory analytical devices and all other equipment capable of producing ionizing radiation.

C. The Radioactivity of Concern

Among the environmental agents of concern as the naval property is turned over to others is radioactivity. This radioactivity comes from two major different groups of sources.

Processes and products common to virtually all large industrial facilities constitute the largest source in terms of total radioactivity. These include radiography sources for non-destructive testing, radiation sources in level gauges, welding electrodes containing ^{232}Th, and electronic and ionization devices containing a variety of radioisotopes.

Another source associated with older military bases is commodities with radioluminescent paint. The paint is given its luminescent property by the incorporation of any one of a number of radioisotopes; the most common of which was ^{226}Ra in the mid-1900's. This type of paint was used by the military for nearly forty years before it was discontinued in the mid-1970s. Various gauges and dials used on aircraft were radioactive. Controls over use of these materials were limited, especially in the early years.

D. General Radioactive Materials (G-RAM)

Radioactive material associated with the RASP is designated as ***general radioactive material,*** *or* ***G-RAM,*** to differentiate it from radioactive material associated with BUMED, the NWRCP and the NNPP. G-RAM includes, but is not limited to, NRC-licensed radioactive material, naturally-occurring radioactive material (NORM), radiographic and instrument calibration sources, and various

instrumentation. Excluded from G-RAM are radioactive material used for medical treatment or diagnosis (BUMED cognizance), nuclear weapons (NWRCP cognizance) and nuclear propulsion (NNPP cognizance).

The RASP is not normally responsible for radioactive materials under the cognizance of BUMED. However, the RASP may be tasked with the final disposition (i.e., disposal) of BUMED-generated radioactive waste as well as authorizing the unrestricted release of BUMED radiological areas. Thus, BUMED radioactive materials may be categorized as G-RAM. See Section 2 paragraph C concerning the Low Level Radioactive Waste Disposal Program.

Radiological potential, or simply ***potential***, refers to the possibility for the presence of radioactive contamination or the existence of radiological hazards as a result of the direct or indirect handling (use, repair and/or storage) of G-RAM.

For the purpose of this survey plan, the buildings and facilities of Naval Support Activity (NSA) Memphis are collectively designated as the ***Site***. Each individual building, facility or area of NSA Memphis that will undergo a G-RAM release survey is designated as a ***specific site***.

E. Purpose of Radiological Surveys to Support Unrestricted Release

To allow for buildings and facilities of NSA Memphis to be returned to the public or other government agencies for unrestricted use, all radioactivity associated with Navy operations must be reduced to an acceptable level. To ensure this is accomplished, extensive surveys with sensitive radiation detection, indicating and computation instruments (RADIACs) will be performed over all areas where radioactive material has been handled or stored. Also, if there are areas where a greater potential for residual contamination exists, solid material samples will be obtained and radioisotopic analysis will be performed on the collected samples. The type and extent of surveys required to release an area will be based on its radiological history. Areas will be classified according to their potential for containing radioactivity. All man-made radioactivity above the limits identified in Section 4 will be remediated. Extensive records will be kept for documentation of this effort. After the process is complete, there should be no restrictions on use of the property.

SECTION 2

SUMMARY OF THE

RADIOLOGICAL AFFAIRS SUPPORT PROGRAM

AND

GENERAL RADIOACTIVE MATERIAL CONTROL

SECTION 2
SUMMARY OF THE RADIOLOGICAL AFFAIRS SUPPORT PROGRAM AND GENERAL RADIOACTIVE MATERIAL CONTROL

A. The Radiological Affairs Support Program (RASP)

The RASP is the vehicle used by the Commander, Naval Sea Systems Command to discharge his responsibility for radiological controls for applicable sources of ionizing radiation. As mentioned in the preceding section, the RASP applies to all ionizing radiation sources including radioactive material licensed by the NRC, NORM, and machine sources capable of producing ionizing radiation. The technical manual which establishes the radiological controls requirements for the RASP is Naval Sea Systems Manual, S0420-AA-RAD-010 (or RAD-010), Radiological Affairs Support Program Manual.

Technical support to include radiological assistance, program review, radiation safety training, and inspection of radiation safety programs is provided by the Naval Sea Systems Command Detachment, Radiological Affairs Support Office (NAVSEADET RASO or, simply, RASO).

B. The Navy Radiation Safety Committee (NRSC)

The Department of the Navy (DON) has been delegated regulatory authority for the receipt, possession, distribution, use, transportation, transfer and disposal of radioactive material at Navy and Marine Corp activities. This authority is derived from a Master Material License issued by the NRC.

The Navy Radiation Safety Committee (NRSC) was established to provide administrative control of all radioactive material used by the Navy and Marine Corp except for nuclear propulsion reactors and associated radioactivity, nuclear weapons, and certain components of weapons delivery systems. Navy Radioactive Material Permits (NRMPs) are used to maintain this control. The Navy issues NRMPs to individual commands which authorize the use of NRC-regulated radioactive material.

There are no records of NRC licenses or Navy permits issued to the former Naval Air Station Memphis.

C. Low Level Radioactive Waste Disposal Program

Commands dispose of radioactive material in accordance with Title 10 of the Code of Federal Regulations and in accordance with specific instructions contained in their NRMP.

The Navy Radiation Safety Committee has established a centrally managed low level radioactive waste (LLRW) disposal program under the auspices of an Interservice Support Agreement with the Department of Army for consolidation, compaction and burial of LLRW. Navy and Marine Corps activities use this program for radioactive waste disposal unless an alternative method is authorized by their NRMP or by the Deputy Chief of Naval Operations, Logistics.

D. Shipment of General Radioactive Material

There is no documented evidence of an inadvertent release of G-RAM radioactivity during the transportation of that material through the NSA Memphis site.

E. Reports of Inadvertent Release

Because of the mission of NSA Memphis (and the former Naval Air Station) and the limited use of G-RAM, the potential for release of G-RAM radioactivity to the environment was minimal.

SECTION 3

SUMMARY OF THE SURVEY PLAN

SECTION 3
SUMMARY OF THE SURVEY PLAN

A. · Scope

This survey plan provides requirements and general instructions for the performance of radiological surveys to support the decommissioning of NSA Memphis and the free release of buildings, facilities and land areas. The survey plan was developed using guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). Surveys will verify the presence or absence of G-RAM related radioactivity in excess of the release limits for unrestricted use. Facilities exceeding the release limits will be remediated prior to release. These surveys are intended to cover only those facilities where G-RAM was used or stored.

There is a very low potential for contamination at levels that pose an increased health risk to personnel where G-RAM, or products containing G-RAM, were used or transported. Review of available history indicates that products containing G-RAM has not resulted in the spread of contamination.

B. Radiological History

For the purpose of this survey plan, *radiological history*, refers to the catalog of facts, written or oral, with respect to the handling or use of radioactive material or radioactivity or other related topics.

C. Survey Plan Considerations

The basic considerations for this survey plan are outlined below.

1. Available historical information on NSA Memphis buildings and facilities was reviewed and evaluated for G-RAM concerns. The catalog of areas included in this Survey Plan are those which will receive G-RAM surveys prior to final release.

2. Known G-RAM will be removed prior to performing the survey of that area.

3. Natural (background) radiation levels and radioactivity concentrations will be determined to distinguish residual radioactivity from that which is naturally-occurring or that which is inherent to commercial or industrial processes.

4. Areas will be divided into classifications based on radiological history and the potential for radioactive contamination.

5. Each specific site will be surveyed and, if necessary, sampled for residual radioactivity.

D. Summary Report

A report summarizing the release survey effort will be prepared and provided to Southern Division Naval Facilities Engineering Command (SODIVNAVFACENGCOM) and NAVSEADET RASO (SEA 07R1). This final report will provide information including, but not limited to, radiological survey results and findings, maps of each specific site, related photographs, and a final radiological assessment. Data will be presented in units consistent with Title 40 of the CFR; specifically, surface radioactivity will be presented in units of counts per minute **(cpm)** or picocurie per one hundred square centimeters **(pCi/100 cm^2)**; and, specific radioactivity (solid media) in units of picocurie per gram (pCi/g).

SECTION 4

RELEASE LIMITS

ENVIRONMENTAL DETACHMENT CHARLESTON

SOUTH CAROLINA

SECTION 4
RELEASE LIMITS

The following criteria will be used to release the Site for unrestricted use.

Surface Contamination Limits. The limits for surface contamination are radionuclide-specific. The surface contamination limits are consistent with those established by the RASP and by the NRC. Table 4-1 lists the surface contamination limits.

Radioactivity Concentration Limits. The radioactivity concentration limit is 5 picocurie per gram (5 pCi/g) above natural background for ^{226}Ra and ^{232}Th in building materials. This limit also applies to solid material (sediment) samples obtained from fluid systems and any other media. This limit is consistent with the Code of Federal Regulations, Title 40, Part 192 (40 CFR 192) for uranium and thorium mill tailings and thorium byproduct material.

Table 4-1. Surface Contamination Limits

Radionuclide [1]	Average [2], [3], [6], [8]	Maximum [2], [4], [6], [8]	Removable [2], [5], [8]
Natural uranium, ^{235}U, ^{238}U, and associated decay products	5,000 dpm α/100 cm² (2,250 pCi/100 cm²)	15,000 dpm α/100 cm² (6,750 pCi/100 cm²)	1,000 dpm α/100 cm² (450 pCi/100 cm²)
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100 dpm/100 cm² (45 pCi/100 cm²)	300 dpm/100 cm² (135 pCi/100 cm²)	20 dpm/100 cm² (9 pCi/100 cm²)
Natural thorium, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000 dpm/100 cm² (450 pCi/100 cm²)	3,000 dpm/100 cm² (1,350 pCi/100 cm²)	200 dpm/100 cm² (90 pCi/100 cm²)
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above [7]	5,000 dpm β-γ/100 cm² (2,250 pCi/100 cm²)	15,000 dpm β-γ/100 cm² (6,750 pCi/100 cm²)	1,000 dpm β-γ/100 cm² (450 pCi/100 cm²)

[1] Where surface contamination by both alpha and beta-gamma emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should be applied independently.
[2] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
[3] Measurements of average contaminant should not be averaged over more than one square meter. For objects of less surface area, the average should be derived for each object.
[4] The maximum contamination level applies to an area of not more than 100 cm².
[5] The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying a moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped. Except for transuranics and ^{226}Ra, ^{228}Ra, ^{227}Ac, ^{228}Th, ^{230}Th and ^{231}Pa alpha emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.
[6] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at one centimeter and 1.0 mrad/hr at one centimeter, respectively, measured through not more than seven milligrams per square centimeter of total absorber.
[7] This category of radionuclides includes mixed fission products, including the ^{90}Sr which is present in them. It does not apply to ^{90}Sr which has been separated from the other fission products or mixtures where the ^{90}Sr has been enriched.
[8] 100 dpm = 45 pCi

SECTION 5

SIGNIFICANT RADIONUCLIDES

SECTION 5
SIGNIFICANT RADIONUCLIDES

A. Technologically-Enhanced Radioactive Material

Technological advancements of the 19th and 20th centuries have intentionally incorporated the use of low-level radioactive materials into manufactured products because of the functional benefits realized from their emission of ionizing radiation. In other products, low-level radioactive material is naturally-occurring and its presence is inherent to the fabrication materials and the manufacturing process; in these items, the emission of ionizing radiation is incidental to their purpose.

Low-level radioactive material, whether technologically enhanced or naturally occurring, has proliferated into the consumer market, thus to the public. The Navy is no exception to this proliferation. Low-level radioactive material is present in concentrated forms found in check sources and radiography sources. It also exist as integral components in aerosol (smoke) detectors and electron tubes and other electronic and ionization devices. Low-level radioactive material is present in its natural form in building construction material.

A ***radioactive commodity*** (or, simply, a ***commodity***) is an item of government property, containing radioactivity equal to or greater than the quantities listed in 10 CFR 20, Appendix C or contains a specific activity greater than 0.002 µCi/gram of radioactive material and to which a National Stock Number (NSN) has been assigned.

Generally, there are five types of NSN-numbered commodities containing radioactivity stocked in the supply system: (1) luminescent (self-illuminating) devices; (2) electronic devices (including electron tubes); (3) ionization devices (including check sources); (4) analytical devices; and, (5) those containing naturally-occurring radioactive material.

Commodities containing NORM, are further subdivided into two sub-types: those where the radioactive constituent is technologically-enhanced (see § 5.B below) for beneficial application of its radioactive properties (e.g., thorium in welding rods) and

those where the radioactive constituent is naturally-occurring and its radioactive properties are incidental to its use (e.g., potassium in dry extinguishing chemicals).

For the purpose of this survey plan, ***technologically-enhanced radioactive material*** is defined as radioactive material that has been physically or chemically processed such that the radionuclide of interest is radiologically enhanced (i.e., its curie content increased) for non-medicinal, beneficial utilization of its nuclear characteristics (e.g., its radioactive decay properties, atomic number, etc.) in a radioactive commodity.

Based on radiological history and knowledge of Site operations, the significant radionuclides associated with the RASP and G-RAM operations is ^{226}Ra because of its technological enhancement in radioluminous products. This radiological contaminant is considered significant because of the physical form in which it existed, the handling, work, and storage practices employed, and/or the disposal methods used.

There are many less significant radiological contaminants which were associated with Navy operations. These are expected to be encountered either as discrete sources or as isolated areas of residual radioactivity. Although the survey schemes of this Survey Plan do not specifically target these additional radionuclides, its is designed to identify and quantify, as necessary, their presence. For example, if a gamma scintillation scan survey detects a sustained increase in radiation levels, the suspect area would received a more detailed survey using a combination of scan, swipe/swab, and/or solid material sampling to identify and quantify the source.

1. Technologically Enhanced Radium

Radioactive materials have been used by the U. S. military for many years in a variety of applications. One of the more common applications was the use of ^{226}Ra as the activating agent in luminescent paint used on gauges and dials in ships and aircraft. Other applications include portable compasses, thermostats, numerous toggle switches, lock illuminators, gun sights, safety devices (exit deck markers and signs), field telephones, and surface lookout alidades. It should be noted that approximately 80% of these devices remain intact. This type of paint was used extensively from prior to World War II through the mid-1970s. Radium-226 was a poor choice of activators because the intense alpha

particle bombardment damages the fluorescent component so that after a few years the item was no longer self-luminous. In the early 1970s, the U. S. Department of Defense formulated a policy that the procurement of ^{226}Ra was to be discontinued unless it was demonstrated that a non-radioactive substitute or less hazardous radioactive substance could not be used. Radium-226 was replaced by the short-term usage of ^{90}Sr and, later, by two other radionuclides, ^{3}H and ^{147}Pm, which are currently used in radioluminous compounds. None of the replacement isotopes are considered a problem. ^{90}Sr and ^{147}Pm will be detected with the instrumentation contained in this plan because of the decay scheme. ^{3}H would not be detected, but it is not considered a problem because there is no known use of this isotope at NAS Memphis. If any ^{3}H used was in a gaseous form it would have long since dissipated.

B. Naturally-Occurring Radioactive Material (NORM)

Naturally-occurring radionuclides common to industrial, commercial and residential environments are those found in buildings materials. Building materials contain primordial radionuclides (terrestrial/crustal sources of radiation) which are very long-lived radionuclides and have existed within the earth since its formation several billion years ago and have not substantially decayed. Because of their use in building material as aggregate, strengtheners and as other key components, their presence is detectable and measurable. Radioactive concentrations vary depending on their crustal geographical origin.

The survey schemes of this Survey Plan account for the presence of NORM in building materials. Although the survey schemes of this Survey Plan do not specifically target these additional primordial radionuclides, its designed to identify and quantify, as necessary, their presence at elevated levels. For example, if a gamma scintillation scan survey detects a sustained increase in radiation levels, the suspect area would receive a more detailed survey using a combination of scan, swipe/swab, and/or solid material sampling to identify and quantify the source. A "sustained increase" refers to an increase in count rates above background radiation levels that remains relatively constant over a period of approximately fifteen seconds.

Table 5-1. Common Radionuclides in Solid Material and Environmental Samples [1]

Radionuclide	Half-life ($T_{½}$)	Gamma Energies (MeV) [2]
Beryllium-7 (^{7}Be)	53.44 days	.477590
Potassium-40 (^{40}K)	1.277 X 10^{9} years	1.460800
Cesium-137 (^{137}Cs)	30.17 years	.661650
Thallium-208 (^{208}Tl)	3.053 minutes	.277350 .583140 .510840 .860370
Bismuth-212 (^{212}Bi)	60.55 minutes	.727170
Lead-212 (^{212}Pb)	10.643 hours	.300090
Bismuth-214 (^{214}Bi)	19.9 minutes	.609310 .768360
Lead-214 (^{214}Pb)	26.8 minutes	.241980 .351920 .295210
Radium-226 (^{226}Ra)	1600 years	.186210
Actinium-228 (^{228}Ac)	6.13 hours	.209280 .794700 .321700 .911070 .338320 .969110

[1] Data extracted from "The Health Physics and Radiological Health Handbook," Edited by Bernard Shleien, July 1992
[2] Photopeaks commonly observed during spectral analysis.

1. Building and Solid Materials

Radionuclides which are common to solid material samples and environmental samples are listed in Table 5-1. With the exception of ^{137}Cs atmospheric fallout from world-wide nuclear explosions (testing), all the listed radioisotopes are naturally-occurring and are progeny in the decay scheme of the primordial radioactive elements.

Gamma spectrometry analysis includes all peaks less than 2100 KeV. The list of radionuclides that will be routinely quantified during gamma spectrometry includes ^{40}K (1461 keV), ^{60}Co (1173 and 1332 keV), ^{137}Cs (662 kev),^{214}Bi (609, 1120, 1238, 1378, 1764, and 1847 keV), ^{214}Pb(75, 77, 87, 242, 295 and 352

keV), ^{226}Ra(186 keV), ^{228}Ac (209, 270, 338, 463, 795, 911, 965, 969 and 1588 keV), ^{235}U (90, 93,144, 163, 186 and 205 keV). Other significant photopeaks detected less than 2100 KeV will be investigated.

2. Radionuclides in Other Commodities

Low-level radioactive material can be found in many naval electronic products used for voltage regulation, current surge protection, and as indicator lights. Voltage regulators and current surge protectors may contain ^{137}Cs, ^{62}Ni, ^{85}Kr or ^{210}Po. Some electron tubes and surge arrestors may contain ^{137}Cs, ^{60}Co, ^{63}Ni, ^{85}Kr, or ^{147}Pm.

Ionization devices include spark gap irradiators containing ^{60}Co and gas and aerosol (smoke) detectors containing ^{241}Am, ^{226}Ra and ^{238}Pu. Other radionuclide-possessing ionization devices include static eliminators, lightening rods, control and measuring instrumentation, anti-static brushes, and precision balances. These latter commodities commonly contain ^{3}H, ^{99}Tc, ^{210}Po, ^{226}Ra, ^{232}Th, or ^{241}Am.

C. Radon

Radon-222 (^{222}Rn) is a decay product of the uranium decay series. At most Navy facilities, the absence of ^{222}Rn at concentrations that pose an increased risk hazard to health, safety, and the environment has been verified by independent tests. These tests were mandated by the Navy Radon Assessment and Mitigation Program (NAVRAMP) which was designed to comply with the U. S. Environmental Protection Agency's (EPA) recommendations for radon measurement.

D. Physical Characteristics: Media-to-Air Volatilization

For accurate quantization Radium-226 needs to be in equilibrium with its daughters. Manipulation of building material allows the radon gas to escape, thus no equilibrium conditions are established. Consequently, samples will be held until equilibrium conditions are established.

E. Nuclear Characteristics: Radioactive Equilibrium

Radioactive equilibrium is a state in which the production of a radioisotope is equal to the decay of the same. Because ^{226}Ra has a very long half life when compared with its progeny, a state of equilibrium will exist between ^{226}Ra and its progeny. This has important implications in quantifying ^{226}Ra concentrations in solid samples, because the concentration of ^{226}Ra is derived from detecting the gamma emissions of the Radium-226 progeny, specifically, ^{214}Bi and ^{214}Pb. The inherent assumption in this derivation is that a state of radioactive equilibrium exists. If a solid sample is removed from its environment, this equilibrium is disturbed and must be allowed to reestablish in order to accurately quantify ^{226}Ra concentrations. During a period of just under a month of radium decay, the equilibrium amount of ^{226}Ra, radon and the other progeny are present and all disintegrate the same number of atoms per unit time.

Because of radioactive equilibrium, special restrictions should be exercised when analyzing solid material samples.

F. Handling Restrictions for G-RAM Solid Material Samples

Radium's physical and nuclear characteristics, media-to-air volatilization (radon emanation) and radioactive decay equilibrium, respectively, require that a holding time be established for potential radium-containing material samples such as cement, concrete, asphalt, brick, and gypsum prior to radioisotopic analysis. ^{232}Th does not have a gaseous intermediate in the decay series and the equilibrium between ^{232}Th and ^{228}Ac is not disturbed during sampling. Thus the parent activity (^{232}Th) can be determined from the daughter (^{228}Ac) activity immediately.

It is required that each sample of building material suspected of containing radium (or associated isotopes) be held and left undisturbed in its container for a period of no less than 27 days.

The sample container should also remain hermetically sealed to preclude further media-to-air volatilization of radon, thoron, and/or actinon gases and to preserve radioactive equilibrium.

SECTION 6

SURVEY AND SAMPLING TECHNIQUES

ENVIRONMENTAL DETACHMENT CHARLESTON
SOUTH CAROLINA

SECTION 6
SURVEY AND SAMPLING TECHNIQUES

A. Equipment Used for Surveys

1. Gamma Scintillation Survey Equipment: IM-253/PD

NOTE: Equivalent instrumentation may be used.

Gamma scintillation surveys will be performed using either:
(1) an Eberline Instrument Corporation, Model E-600 count rate meter with a Model SPA-3 scintillation probe assembly;
(2) a Nuclear Research Corporation, Model IM-253/PD count rate meter with a DT-640 scintillation probe assembly;
(3) a Nuclear Research Corporation, Model CRM-595 count rate meter with a GP-595 scintillation probe assembly; or,
(4) an equivalent RADIAC.
These instruments are equivalent and will be referred to as an ***IM-253/PD*** and will be used to detect gamma radiation over a broad energy range.

The gamma scintillation detector probe consists of a cylindrical housing containing a 2-inch diameter by 2-inch long sodium iodide with thallium [NaI(Tl)] crystal. It has a linear scale ranging from 0 to 1,000 counts per minute (cpm). Scale multipliers of X1, X10, X100, and X1,000 are selected according to the radiation levels being measured.

The IM-253/PD will be calibrated to respond to an energy range which includes the ^{226}Ra gamma ray of 0.1862 MeV while in the pulse height analyzer (PHA) counting mode. This RADIAC normally responds to energies from 0.1 MeV to approximately 8.0 MeV while in the GROSS mode. The PHA mode measures low level radiation over a narrow gamma energy range whereas the GROSS mode allows a wide energy range to be detected. Each instrument will be re-calibrated at least annualy while in use.

Each instrument will be response source checked daily prior to its use in conducting surveys. This check will consist of verifying that the needle of the meter responds correctly to a known value (^{226}Ra check source).

Typical detection characteristics of the IM-253/PD are an accuracy of ± 20% and a minimum sensitivity of 100 cpm.

2. Beta-Gamma Survey Equipment: IM-247/PD

Direct scan surveys for beta and gamma radioactivity will be performed using a DT-304/PDR Geiger-Müeller frisker probe, attached to a suitable rate meter. The DT-304/PDR probe is a directional probe utilizing a tungsten shield. The SHP-360 probe is the unshielded version of the DT-304/PDR. The two aforementioned probes are the most common Geiger-Müeller probes used in the Navy and are considered equivalent; they will be referred to as the ***DT-304/PDR***. These probes will be used in conjunction with either an Eberline E-140N, E-600, a Johnson & Associate, Inc. IM-247/PD, or a RAM-3400 or RM-3C frisker, or equivalent. These instruments and probes are equivalent and will be referred to as an ***IM-247/PD***. They will be used to detect both fixed and loose surface radioactive contamination.

This RADIAC is used to detect both fixed and loose surface radioactive contamination. It has three linear scales of 0 to 500, 0 to 5,000, and 0 to 50,000 cpm. The DT-304/PDR probe or equivalent consists of a 900 V, 2-inch diameter flat Geiger-Müeller tube having a window thin enough to transmit a high percentage of the low energy beta particles, less than 200 keV betas.

Each instrument will be response source checked daily prior to its use in conducting surveys. This check will consist of verifying that the indication of the meter responds correctly to a known value (^{99}Tc check source, mainly 204 and 293 keV beta energies). Each instrument will be re-calibrated at least annually while in use. Since the presence or absence of various naturally occurring radioisotopes and the equilibrium state of Radium is unknown, IM-247/PD scans will be used for detection purposes only.

B. Survey Techniques

1. Scan Surveys

Scan surveys will be performed such that 100% of the surface of each grid or sub-grid is monitored. Grids and sub-grids are defined and specified in Section 8.

A wide energy band, gamma scan survey will be conducted with an IM-253/PD with a SPA-3 probe, or equivalent, operating in the GROSS mode. A narrow energy band, gamma scan survey will be conducted with an IM-253/PD, or equivalent, operating in the PHA mode. In the PHA mode the instrument will detect photons from ^{214}Pb which is a decay isotope of ^{226}Ra. A reading exceeding twice background in either mode requires investigation and identification of cause.

A beta-gamma scan survey will be conducted with an IM-247/PD. Any level equal to or greater than the respective limit shall be considered unsatisfactory and additional surveys will be required to determine the extent and magnitude of contamination. Since the presence or absence of various naturally occurring radioisotopes and the equilibrium state of Radium and Thorium is unknown, IM-247/PD scans will be used for detection purposes only.

Scanning speeds (rate of probe movement) normally will be one to two inches per second for gamma scintillation and beta-gamma surveys. Scan rates should also be reduced when surveying in areas with high background or fluctuating radiation levels wherein the detection of radioactivity above the limit is more difficult to distinguish.

The scanning detector will be held within one-half inch of the surface for gamma and beta-gamma measurements. The detector should be held such that its most sensitive portion is parallel to the surface. Scanning practices include using the audible response (speakers or headphones) of the RADIAC for detection and, after stabilization, using the meter response for measurement.

2. Walk-Through Surveys

Walk-through surveys will be performed with a gamma scintillation meter (IM-253/PD) operating in the GROSS mode and a beta-gamma survey meter (IM-247/PD). Walk-through surveys will be performed by holding the detector probe approximately three feet above the deck/floor and walking slowly through the specific site and stopping every ten feet (approximately) to take static measurements. Static (point) measurements will also be taken when sustained increases in count rates are observed. Walk-through survey practices include using the audible response (speakers or headphones) of the RADIAC for detection and, after stabilization, using the meter response for measurement. The speed of the walk-through surveys will be no more than one foot per second.

Walk-through surveys will be designed such that a representative portion of the specific site is surveyed. Experience has shown that surveying along paths approximately five to six feet apart provides a representative measurement of potentially deposited surface contamination.

Surveys will include traverse routes, tool storage areas, office spaces and work areas. Any sustained increase above background will be investigated by a more detailed survey of the suspect area.

Surveys performed in low potential areas will include the walk-through surveys supplemented by a detailed scan survey of approximately one-third of desks, lockers, drawers, and their associated contents. Low potential areas include secretarial areas, private offices, bathrooms, dressing areas, and areas where personal items are stored.

Surveys performed in high potential areas will include the walk-through surveys supplemented by a detailed scan survey of approximately one-half desks, lockers, drawers, and their associated contents. High potential areas include machine shops, shop offices, tool rooms, storage rooms, calibration rooms, traverse routes from radiological areas, and other work areas of radiation workers.

3. Removable Surface Contamination Surveys: Swipes/Smears and Swabs

Surveys for surface contamination will be performed as necessary to determine if radioactivity above the limit is removable, or loose. Surveys for loose surface contamination will be performed by wiping a 100 cm^2 surface applying moderate pressure with a dry filter paper (smear/swipe). This area gives an optimum efficiency for collecting and measuring radioactive contamination. Wet smears/swipes are permissible for monitoring wet or damp areas and when surface contamination is suspected but may not be detected using dry filter paper. Measurements of a contaminant will not be averaged over more than one square meter. For objects of less surface area, the average should be derived for each object.

Loose surface contamination surveys may also be performed using cotton swab-type methods. Since counting efficiencies for swabs have not been developed, swabs will be used for detection purposes only.

Swabs may be used to survey accessible cracks and crevices where potential residual radioactivity may not be detected by other survey methods. For each specific site, an evaluation will be made for radiological potential. From this, the locations and number of actual cracks and crevices to be surveyed will be specified in technical work instructions. Due to major renovations of some specific sites, it is not unreasonable to specify that very few cracks or crevices (or even none) be surveyed. This is permissible since some renovations may involve complete demolition, re-construction, or re-surfacing of a specific site where actual surfaces onto which residual radioactivity is more likely to be deposited no longer exists. However if these situations are discovered, an equivalent alternative method of verifying an absence of contamination will be executed.

Swipes/smears and swabs will be monitored in the field using portable RADIACs capable of detecting gamma radiation. Swipes and swabs will also be analyzed for gamma radiation using laboratory gamma spectrometry.

In the event contamination is suspected to be above the limit, other survey methods will be used to quantify the contamination. Surveys performed as a result of contamination detected on swabs are dependent on the type, extent

and magnitude of potential contamination in the suspected affected area. Each occurrence will be handled on a case basis. Engineering evaluation will be performed to assess the contamination potential and additional surveys will then be prescribed.

4. Supplemental Surveys

Remaining ventilation ducts, electrical boxes, conduit or other interior surfaces of equipment in affected areas which may contain residual contamination, will be accessed at random and surveyed by scanning, swiping or swabbing. Special surveys also will include surfaces which have remained undisturbed over an extended period of time; the top surfaces of suspended light fixtures including emergency lighting, structural, overhead girders, the top of window sills and door frame molding, surfaces under large shelves and furniture, and surfaces between electrical conduit and the wall are typical examples.

5. Fluid System Surveys

Fluid systems suspected of being exposed to radioactivity shall be surveyed. These systems will be opened at convenient locations for access and appropriate surface contamination surveys performed. Also, some system accumulators will be accessed and surveyed for radioactivity. Accumulators include valves, strainers, S- and U-shaped bends, traps, areas of low fluid flow, and other areas where particulate may have settled or mixed with sediment. If present, solid sediment samples will be obtained and evaluated for the presence of residual radioactivity. If activity is detected, it will be identified and quantified. Additionally, more extensive surveys will follow if radioactivity above a limit is suspected.

6. Solid (Surface) Material Samples

Solid (and surface) material samples refer to samples of surface material such as concrete, asphalt, wood, and other building material retrieved from a specific site for analysis of radioactivity concentration. Samples also include facial materials such as paint, wall paper and floor tile. Sampling will be conducted by obtaining a representative sample of the surface. Typical surface sampling parameters of dense media include: a 7-inch diameter, circular surface area

that corresponds to approximately 250 cm^2; a sampling depth of approximately ⅛ to ¼ inch; a sample mass of 20 grams; and, radioisotopic analysis under a petri dish geometry. Each sample will be analyzed via gamma spectrometry and the radioactive concentration (specific radioactivity) determined and presented in pCi/g. The specific radioactivity will then be mathematically equated to surface contamination and presented in pCi/100cm^2 or dpm/100cm^2.

The 27-day holding time applies to solid material samples as specified in Section 5 paragraph F.

7. Solid Material Core Sample

A ***solid material core sample***, or ***core sample***, is a sample of building material obtained by a mechanical device such that an intact, cylindrical column of material is retrieved. Core samples may be required to aid in determining the extent and magnitude of an area known to be contaminated. Thus, core samples may be collected as necessary to aid in determining contaminant concentrations below surface level (i.e., deeper than approximately ¼-inch). Core samples may also be obtained to aid in establishing a background radioactivity concentration to which specific site samples may be compared.

Solid material core samples will be obtained by drilling with a core drill bit to a depth sufficient to obtain a sample representative of the radioactivity deposited or naturally-occurring in that area. Material from the core will be pulverized, if necessary, and mixed to provide a homogeneous sample. Material representative of each plug will be removed to provide a minimum sample of 20 grams. Analysis of these samples will be similar in scope to that of surface material samples described in the previous section.

8. Control of Samples

A ***sample*** is any media that is removed from a particular area for the purpose of radioisotopic evaluation. Samples include, but are not limited to, swipes/smears, swabs, solid material samples, sediment samples.

Good radiological sampling practices will be exercised to preclude potential cross-contamination between samples and sample locations. Sampling tools,

equipment and containments will be cleaned prior to reuse at another sampling location.

Upon collection, each sample shall be placed in a suitable container (e.g., small plastic bag). Each will be clearly marked with the grid/sub-grid from which it was collected and with the date. Each sample will have its own unique identifier.

Each sample container will be sealed such that sample integrity and authenticity is maintained and tampering precluded. Each sample container will be sealed at the point of generation (i.e., at the work site). The use of a sample seal sticker placed across the opening/lid of the sample container has proven to be an effective tamper seal. Also, thermal sealers have effectively sealed plastic bags.

The ***Chain-of-Custody Record*** is the vehicle used to document possession of samples to ensure each is traceable from the time of collection to the time of actual laboratory analysis. The Chain-of-Custody Record is used to document ownership or possession of a sample(s) and not to account for its/their movement or transport. Chain-of-Custody Records shall be used for solid material samples collected by this survey instruction.

A sample is considered to be in custody if: (1) it is in the transferee's actual possession; or (2) it is in the transferee's view, after being in his/her physical possession; or (3) it was in the transferee's physical possession and then he/she secured it to prevent tampering; or (4) it is placed in a designated secure area. A transfer of custody is not required when samples are being inspected at the same location as the transferee.

A ***transferee*** is any person or team having physical possession of a sample. Transferees common to shipyard closure efforts include sampling teams, analytical laboratories, and sample preparation teams. Sample preparation teams are considered to be transferees only when they are independent of the sampling team or laboratory.

Once the Chain-of-Custody Record is completed, it will become an accountability document and will be maintained in the project file, survey work package or other documents.

C. Natural Background Determination

1. Analogous Areas

Analogous or ***reference areas*** are areas from which radiological measurements are taken for the purpose of establishing data that represents radiation and/or radioactivity natural to the environment or natural to industrial or commercial processes including construction or fabrication. These analogous/reference areas should not be contaminated or potentially contaminated with G-RAM as a result of work (operations) or conditions incidental to work; that is, these areas should be ***unaffected by site operations***.

Analogous areas should be of similar age and construction materials to those of the specific site to the extent that is practical. If an analogous building or area is not available, the building or area to be surveyed may be used for determination of its own background provided the respective specific site has not been affected by site operations.

2. Determining Background Radiation and Radioactivity

Natural background radiation levels (cpm, or pCi/100cm^2) and radioactivity concentrations (pCi/g) will be determined by taking measurements of the radiation of concern with the respective RADIAC at locations which are unaffected by site operations.

Portable RADIAC and counting system Minimum Detectable Activities (MDAs) will be determined from background radiation determination results. The MDA of an instrument is the smallest amount of activity sufficiently above background that can be detected in a reasonable counting time. These MDA calculations will be isotope-specific. MDAs will be furnished in the final report.

For determining background radiation levels and radioactivity, data set distributions will be established.

SECTION 7

RADIOLOGICAL SURVEY STRATEGY

SECTION 7
RADIOLOGICAL SURVEY STRATEGY

Actions required to support unrestricted release of a specific site are as follows:

(1) Review available history to assess the radiological status of the area.

(2) Identify specific areas that will require a G-RAM release survey based on the review of history.

(3) Prepare work instructions for performing the release surveys.

(4) Transfer all permitted-G-RAM to a recipient authorized by an NRMP, NRC license, or Agreement State license to receive the G-RAM; or dispose of all G-RAM as radioactive waste.

(5) Ensure that all contaminated equipment and/or components are removed from each specific site.

(6) Ensure that all other equipment, components, and fixtures that will interfere with survey efforts are removed from each specific site.

(7) Photograph each specific site before and after the free release process.

(8) Mark each specific site with its pre-determined grid pattern.

(9) Conduct background radiological surveys at locations which were not affected by Site operations.

(10) Conduct the release surveys.

(11) Perform mitigatory or remedial actions as dictated by survey results. These corrective actions will be performed in compliance with separate plan-of-action documents and as detailed in separate technical work documents.

(12) Review survey results for survey completeness, technical accuracy and proper documentation.

(13) Prepare a report summarizing the release survey effort and its results.

SECTION 8

SURVEY METHODOLOGY

SECTION 8
SURVEY METHODOLOGY

A. G-RAM Survey Classes

To establish the surveying, sampling and gridding requirements, the Site has been categorized into different classifications based on contamination potential.

A ***Class 1*** area is one where G-RAM, or products containing G-RAM, were used or stored and radiological history indicates that it has the highest potential for small areas of activity above the limits identified in Table 4-1.

A ***Class 2*** area is one where G-RAM, or products containing G-RAM, were used or stored and radiological history indicates that potential existed for contamination levels at or slightly above the limits identified in Table 4-1.

A ***Class 3*** area is one where its age and the availability of documented history or anecdotal information regarding previous use or storage of G-RAM, or products containing G-RAM, is inadequate or incomplete to discount the potential presence of residual contamination levels. A Class 3 area may, however, have an unknown or incomplete history of use or storage of products with trace quantities of G-RAM which were generally exempt from existing controls and regulations. Due to inadequate evidence to the contrary, prudence dictates that a survey be performed. In a Class 3 area there is no known history of radioactive spills and no documented evidence of radioactive contamination.

B. Survey Requirements

The following section provides the survey requirements for each Class. Table 8-1 summaries the requirements for each of the survey classes.

Each specific site will be marked and divided in the manner outlined in the following subsections. Typically, a grid system will be labeled such that each grid is uniquely identified with an abscissa-ordinate coordinate as in a two-dimensional Cartesian system. The abscissa will be labeled with letters while the ordinate will be labeled with numerals. The result is an alpha-numeric designator, such as A1, B2, AA1, BB22, etc., that is unique to each grid. Sections of grids, referred to as sub-grids or

quadrants, will typically be labeled with Roman numerals. Subsequently, sub-grids will have typical identifiers such as A1-I, B2-II, C3-III, etc.

- The survey schemes of this Survey Plan specify typical grid sizes. However, it is recognized that specific sites vary in their sizes and configurations. Therefore, slight adjustments to grid sizes will be required. When adjusting the grid sizes, efforts will be made to ensure that the extent and symmetry to which the specific site is surveyed (that is, its ***survey coverage***) is not changed. This is to preclude performing surveys which are not representative of the specific site.

1. Class 1 Survey Requirements

   a. Refer to Figure 8-1 for illustrative clarity.

   b. Deck/floor surfaces will be divided and marked into 5-foot by 5-foot square grids. The lower 6-foot surfaces of each wall will be horizontally divided into 5-foot grids to effect a pattern of grids 6-feet high and 5-feet wide.

   c. Each grid will be identified with a unique designation.

   d. A narrow gamma energy range scintillation scan survey (IM-253/PD operating in the PHA mode) will be performed over 100% of the grid surface.

   e. A wide gamma energy range scintillation scan survey (IM-253/PD operating in the GROSS mode) will be performed over 100% of the grid surface.

   f. A beta-gamma scan survey (IM-247/PD) will be performed over 100% of the grid surface.

   g. A minimum of one swipe/smear will be taken in each grid.

   h. Approximately 25% of accessible cracks and crevices in the specific site will be surveyed via swabs. Accessibility to, the location of, and the number of cracks and crevices will be determined by engineering evaluation and will be based on radiological potential.

i. If necessary, a solid surface material sample will be taken from each grid. The location of the sample will be based on the results of the radiological surveys described previously. The sample will be taken from the areas of the grid having the highest potential for radioactivity (i.e., the area having the highest reading).

j. The radioactive concentration (as determined by gamma spectrometry in units of pCi/g) of solid material sample(s) previously collected in each grid will be mathematically equated to surface contamination (in units of dpm/100 cm^2 or pCi/100 cm^2). Calculations will be based on samples collected over an approximate surface area of 250 cm^2.

k. Remaining ventilation ducts, electrical boxes, conduit or other interior surfaces of equipment and services in affected areas, which may contain residual contamination, will be accessed at random and surveyed by scanning, swiping or swabbing. Surveys of undisturbed surfaces shall also be performed.

l. Fluid systems having a potential of being radioactively contaminated shall be accessed and surveyed for surface contamination. Solid sediment, if available, shall be evaluated with an MCA.

2. Class 2 Survey Requirements

a. Refer to Figure 8-2 for illustrative clarity.

b. Deck/floor surfaces will be divided and marked into 10-foot by 10-foot square grids. The lower 6-foot surfaces of each wall will be horizontally divided into 10-foot grids to effect a pattern of grids 6-feet high and 10-feet wide.

c. Each deck/floor grid will be sub-divided into quadrants to effect four 5-foot by 5-foot square sub-grids.

d. Each wall surface will be sub-divided into quadrants to effect a pattern of sub-grids 3 feet high and 5 feet wide.

e. Each grid and quadrant/sub-grid will be identified with a unique designation.

f. A narrow gamma energy range scintillation scan survey (IM-253/PD operating in the PHA mode) will be performed over two diagonal quadrants to represent 50% of the grid surface.

g. A wide gamma energy range scintillation scan survey (IM-253/PD operating in the GROSS mode) will be performed over the other two diagonal quadrants to represent the remaining 50% of the grid surface.

h. A beta-gamma scan survey (IM-247/PD) will be performed over 100% of the grid surface.

i. A minimum of two swipes/smears will be taken in each grid.

j. Approximately, 10% of accessible cracks and crevices in the specific site will be surveyed via swabs. Accessibility to, the location of, and the number of cracks and crevices will be determined by engineering evaluation and will be based on radiological potential.

k. If necessary, a solid surface material sample will be taken from each grid. The location of the sample will be based on the results of the radiological surveys described previously. The sample will be taken from the areas of the grid having the highest potential for radioactivity (i.e., the area having the highest reading). If no area(s) has been identified, the sample will be taken near the center of the grid.

l. The radioactive concentration (as determined by gamma spectrometry in units of pCi/g) of solid material sample(s) previously collected in each grid will be mathematically equated to surface contamination (in units of dpm/100 cm^2 or pCi/100 cm^2). Calculations will be based on samples collected over an approximate surface area of 250 cm^2.

m. Remaining ventilation ducts, electrical boxes, conduit or other interior surfaces of equipment and services in affected areas, which may contain residual contamination, will be accessed at random and surveyed by

scanning, swiping or swabbing. Surveys of undisturbed surfaces shall also be performed.

n. Fluid systems having a potential of being radioactively contaminated shall be accessed and surveyed for surface contamination. Solid sediment, if available, shall be evaluated with an MCA.

3. Class 3 Survey Requirements

a. Refer to Figure 8-3 for illustrative clarity.

b. Size of grids to be determined on site.

c. No sub-grids required.

d. Each grid will be identified with a unique designation.

e. A narrow gamma energy range scintillation scan survey (IM-253/PD operating in the PHA mode) is not required unless survey readings require further investigation.

f. A wide gamma energy range scintillation walk-through scan survey (IM-253/PD operating in the GROSS mode) will be performed over the specific site.

(1) Surveying will be performed along paths approximately five to six feet apart such that representative measurements of potentially deposited surface contamination is obtained.

(2) At approximately ten-foot intervals along the survey path, wide gamma energy range scintillation point (static) measurements (IM-253/PD operating in the GROSS mode) will be taken.

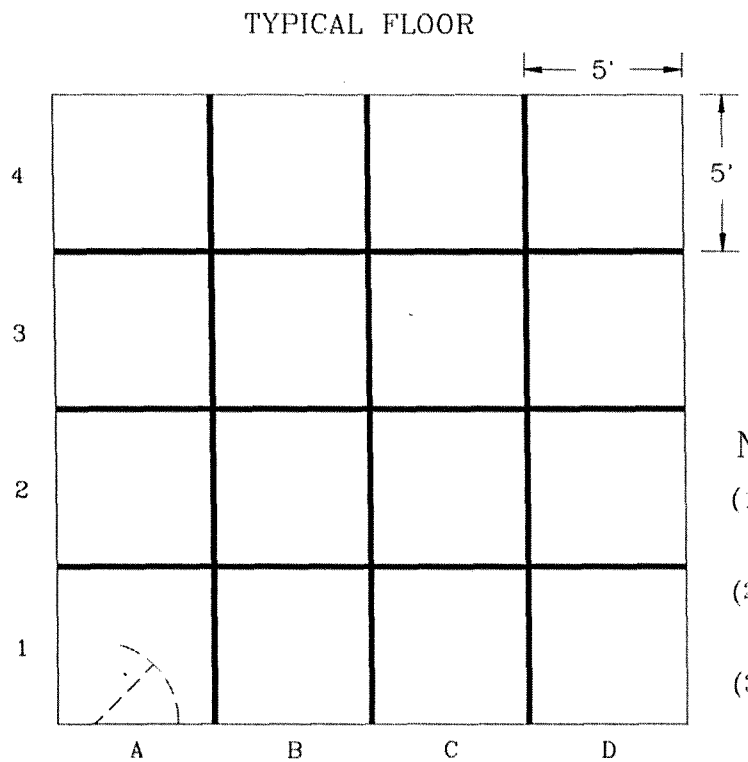
(3) Point (static) measurements are required when sustained increases in count rates are observed.

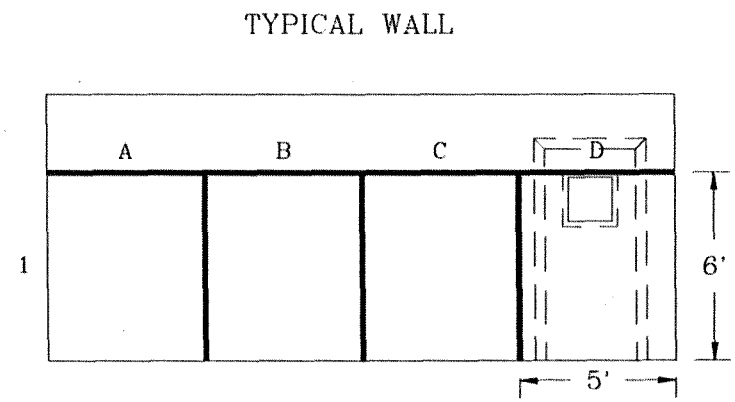
(4) If it becomes necessary to quantify surface contamination, solid (surface) material samples will be collected from the suspect location for accurate assessment.

(5) Walk-through surveys performed in high potential areas (i.e., scrap bins) will include the walk-through surveys supplemented by a more concentrated scan survey.

g. Swipes are not required on outdoor surfaces such as soil or asphalt.

Figure 8-1. Typical Class 1 Grid System and Scan Survey Scheme





Notes:

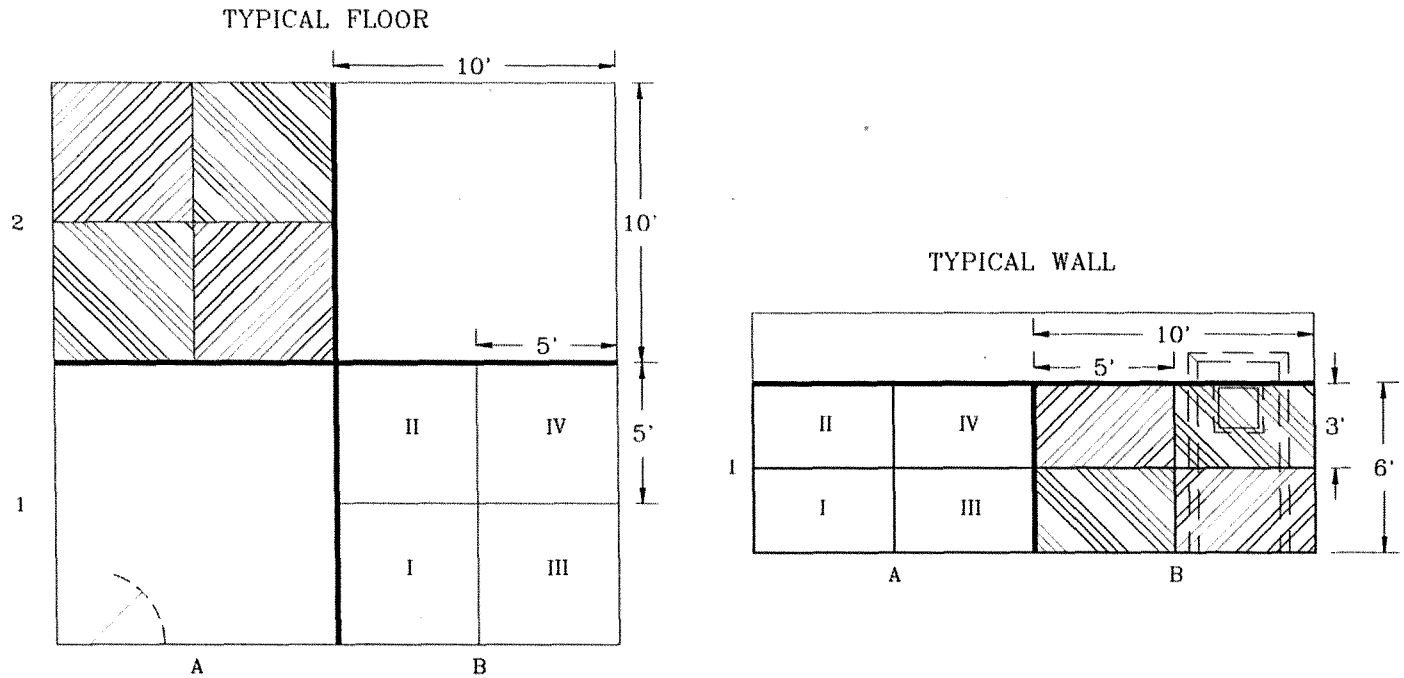
(1) 100% of each grid will receive a beta-gamma scan survey (i.e., IM-247/PD).

(2) 100% of each grid will receive a narrow range gamma scan survey (i.e., IM-253/PD operating in the PHA mode).

(3) 100% of each grid will receive a wide range gamma scan survey (i.e., IM-253/PD operating in the GROSS mode).

(4) The lower six feet of each wall will be gridded and surveyed.

Figure 8-2. Typical Class 2 Grid System and Scan Survey Scheme



Legend:

Denotes sub-grids to receive a narrow range gamma scan survey (i.e., IM-253/PD operating in the PHA mode). This survey scheme represents 50% survey coverage of each grid.

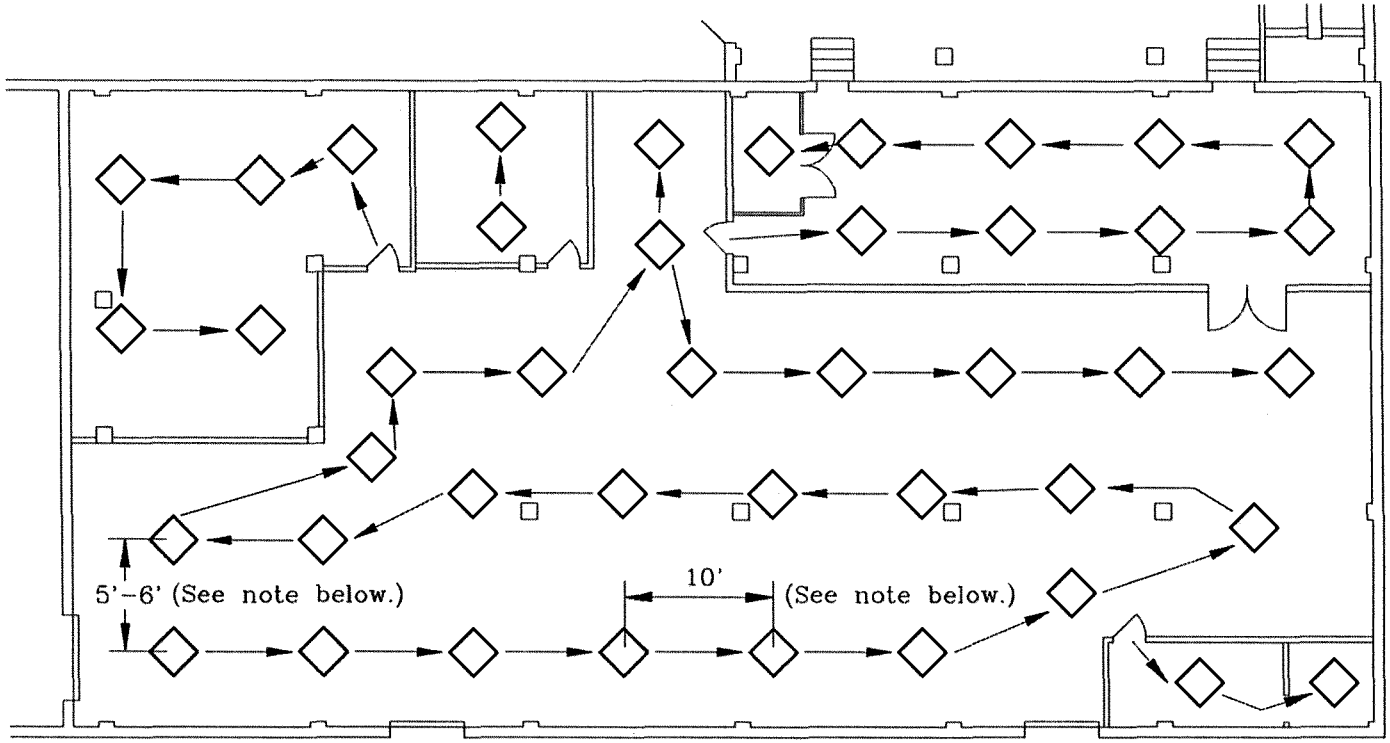
Denotes sub-grids to receive a wide range gamma scan survey (i.e., IM-253/PD operating in the GROSS mode). This survey scheme represents an additional 50% survey coverage of each grid.

Notes:

(1) 100% of each grid will receive a beta-gamma scan survey (i.e., IM-247/PD).

(2) The lower six feet of walls will be gridded and surveyed.

Figure 8-3. Typical Class 3 Walk-through Survey Scheme



Legend:

→ Denotes typical survey path.

◇ Denotes typical location of point (static) measurements.

Notes:

(1) Survey paths are typically parallel and five to six feet apart.

(2) Point (static) measurements are typically taken at ten foot intervals.

(3) Walk-through surveys are performed with the IM-253/PD, gross mode.

Table 8-1. Surveying and Sampling Requirements According to Class

Requirement	Class 1 Area	Class 2 Area	Class 3 Area
Grid System	5' X 5' deck grids. Lower 6' of walls divided every 5' to effect 5'(w) X 6'(h) grids.	10' x 10' deck grids. Lower 6" of walls divided every 10' to effect 10'(w) X 6'(h) grids.	Judgmental
Sub-Grid System	Not required	5' X 5' deck quadrants 5'(w) X 3'(h) wall quadrants	Not required
Narrow γ Energy Range Scan Surveys (IM-253/PD: PHA)	100% of grid surface	50% of grid surface	Not required
Wide γ Energy Range Scan Surveys (IM-253/PD: GROSS)	100% of grid surface	Remaining 50% of grid surface	Walk-through survey
β-γ Scan Surveys	100% of grid surface	100% of grid surface	Not required
Swipes (Smears)	1 (minimum)	2 (minimum)	Not required
Swabs	See Note 1	See Note 1	Not required
Solid Material Sampling	Survey results will determine the number and location of samples to be taken.		
Supplemental Surveys[1]	Required only for Class 1 & 2 Areas. Remaining ventilation ducts, electrical boxes, conduit or other interior surfaces of equipment and services, which may contain residual contamination, will be accessed at random and surveyed by scanning, swiping or swabbing. Surveys of undisturbed surfaces shall also be performed.		
Fluid System Surveys[1]	Required only for Class 1 & 2 Areas. Fluid systems having a potential of being radioactively contaminated shall be accessed and surveyed for surface contamination. Solid sediment, if available, shall be evaluated with an MCA.		

1. Accessibility, location and number to be determined via engineering evaluation and will be based on radiological potential.

SECTION 9

SPECIFIC SITE INFORMATION

ENVIRONMENTAL DETACHMENT CHARLESTON

SOUTH CAROLINA

SECTION 9
SPECIFIC SITE INFORMATION

A. General

Information regarding each specific site is presented after review of available historical records and personal interviews with current and former employees.

A brief history and any pertinent historical information is presented.

In the description of each specific site, the basic construction features are addressed. Naturally-occurring radioactive material in construction materials may contribute significantly to natural background radiation levels. Also, the approximate floor surface area is provided.

The location of each facility is identified by a grid number. This number corresponds to the grid at or near which the facility is located on Public Works Drawing titled, "Map of Naval Support Activity Memphis" dated 9 February 1996.

The radiological significance of each specific site is provided where information is available.

B. Specific Site Information

1. Facilities With Limited Radiological History

Facilities listed as having *"limited radiological history"* in this section are categorized as such due to their age and the limited availability of documented history or anecdotal information regarding previous use or storage of G-RAM, or products containing G-RAM. Also, radiological history of some of these facilities may not be completely known but a potential exists for use and/or storage of G-RAM. Regardless, due to this lack of information, the potential presence of residual contamination can not be discounted.

Areas having a history for storage of material (i.e., scrapyard) are listed in this section. This specific sites is categorized as a Class 3 area because of the extremely low potential for the uncontrolled release and spread of radioactivity from

radioactive commodities. Generally, these items remained in a usable condition and any subsequent damage or breakage incident to normal usage or storage would not have resulted in a significant spread of radioactive contamination. Breakage and curie content of these commodities are at such a level that accidental spread would not result in radiation levels that would pose a significant health hazard.

In these facilities and buildings there is no known history of radioactive spills and no evidence of radioactive contamination.

Each facility listed in this section will receive a Class 1 or Class 3 survey.

a. Building N-126

Building N-126 was constructed as an aircraft hanger in 1955 and contains 77,810 square feet of surface area. The building is made of concrete and block and has a concrete slab. Two story office wings are located on each side of the hanger. It has been continuously used as an aircraft hanger for maintenance and operations support. Building N-126 can be found at or near grid 58-3B of Public Works Drawing titled, "Map of Naval Support Activity Memphis" dated 9 February 1996. Building N-126 is currently leased to the City of Millington.

Specific areas in Building N-126 will receive a Class 1 survey.

b. Facility 885

Facility 885 was constructed in 1944 and consists of approximately 5,700 square-yards of open storage area. The middle area of the yard is asphalt, the east and west ends of the yard are gravel. The yard is used to store scrap metal, computers, machinery, and old. Facility 885 can be found at or near grid 56-P of Public Works Drawing titled, "Map of Naval Support Activity Memphis" dated 9 February 1996. Morale, Welfare and Recreation (MWR) is the current tenant/controlling command.

Facility 885 will receive a Class 3 survey.

SECTION 10

QUALITY ASSURANCE PROGRAM

SECTION 10
QUALITY ASSURANCE PROGRAM

A. Project Description

The scope of this survey plan involves the radiological survey of specific sites at NSA Memphis to provide for their unconditional release. The specific sites are described in Section 9. A summary of the scope of the survey plan is found in Section 3.

B. Project Organization

The Supervisor of Shipbuilding, Conversion and Repair, Portsmouth VA, Environmental Detachment Charleston, SC is responsible for the planning and execution of the survey, assessment of survey results and generation of a final report of the resultant radiological survey at NSA Memphis. Southern Division Naval Facilities Engineering Command is the authority for funding the project. The Radiological Affairs Support Office provides technical support, survey equipment and approval of the survey plan for the Navy.

C. Data Collection and Assessment of Data

Radiological data collection will be performed by personnel specifically trained to operate RADIACs and assemble and record radiological parameters.

The survey will be performed by Messers. Danny Hughes [phone (803) 743-6777 ext. 122] and Tommy Hardin [phone (803) 743-6777 ext. 222] of the Navy's Supervisor of Shipbuilding, Conversion and Repair, Portsmouth VA, Environmental Detachment Charleston, SC. These individuals have 30 years of radiological control experience which includes field surveying, calibration of analytical instruments, radiological project management, radiation safety, data evaluation, record keeping, and audits and surveillances. The survey will be conducted using properly calibrated instruments (described in Section 6) which are sensitive to the potential radioactive contaminant.

Scanning surveys and direct measurements will be taken as described in Section 8.

Detection, measuring, and analytical equipment will be maintained, calibrated and tested to assure the validity of the survey data. Calibration of the instruments will be performed by the Navy's Radiological Affairs Support Office using the manufacturer's calibration protocol to a National Institute of Standards traceable source. Daily source checks will be performed to verify proper operation of the survey equipment. Also, a Quality Control Point will be taken at the start of each survey and a second Point will be taken at the end of the survey to verify proper operation of the equipment.

If solid material sampling is required as indicated by the survey results, samples will be gathered individually and sealed in clean containers. Containers will be marked indicating location and grid number. Sampling equipment will be cleaned between each sampling event to ensure no cross contamination. Section 6 describes the Chain-of-Custody requirements.

Self audits will be conducted daily on the data collected. Data will be recorded in an orderly and verifiable manner and reviewed for accuracy and consistency. Recording of data and certification of completed reports and actions will be performed to ensure completeness, accuracy, and traceability. Additionally, the QA/QC branch of the Environmental Detachment Charleston will perform a verification of the survey data.

D. Implementation of Planned Operations

The radiological survey will be performed in accordance with the guidelines established in this survey plan and QA plan. Data management will include consistent methods of data generation, handling, computations, evaluation, and reporting. All data recorded will be maintained by the Department of the Navy or its designee.

APPENDIX A

LIST OF ABBREVIATIONS AND ACRONYMS

ENVIRONMENTAL DETACHMENT CHARLESTON

SOUTH CAROLINA

APPENDIX A
LIST OF ABBREVIATIONS AND ACRONYMS

^{227}Ac - Actinium-227
^{228}Ac - Actinium-228
^{241}Am - Americium-241
^{133}Ba - Barium-133
^{212}Bi - Bismuth-212
^{214}Bi - Bismuth-214
^{7}Be - Beryllium-7
^{137}Cs - Cesium-137
^{14}C - Carbon-14
^{109}Cd - Cadmium-109
^{36}Cl - Chlorine-36
^{60}Co - Cobalt-60
^{3}H - Hydrogen-3 (Tritium)
^{125}I - Iodine-125
^{126}I - Iodine-126
^{129}I - Iodine-129
^{131}I - Iodine-131
^{133}I - Iodine-133
^{85}Kr - Krypton-85
^{40}K - Potassium-40
^{22}Na - Sodium-22
^{62}Ni - Nickel-62
^{63}Ni - Nickel-63
^{231}Pa - Protactinium-231
^{212}Pb - Lead-212
^{214}Pb - Lead-214
^{147}Pm - Promethium-147
^{210}Po - Polonium-210
^{238}Pu - Plutonium-238
^{223}Ra - Radium-223
^{224}Ra - Radium-224
^{226}Ra - Radium-226
^{228}Ra - Radium-228
^{219}Rn - Radon-219 (actinon)
^{220}Rn - Radon-220 (thoron)
^{222}Rn - Radon-222 (radon)
^{90}Sr - Strontium-90
^{99}Tc - Technetium-99
^{208}Tl - Thallium-208
^{228}Th - Thorium-228
^{230}Th - Thorium-230
^{232}Th - Thorium-232
^{232}U - Uranium-232
^{235}U - Uranium-235
^{238}U - Uranium-238
^{90}Y - Yttrium-90

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

100 cm^2 - one hundred square centimeters
α - alpha, lower case Greek character
β - beta, lower case Greek character
γ - gamma, lower case Greek character
cpm - counts per minute
dpm - disintegration per minute
keV - kilo-electron volt
MeV - mega-electron volt
ml - milliliter
mrad/hr - millirad per hour
μCi/100 cm^2 - microcurie per one hundred square centimeters
μR/hr - microroentgens (microröntgen) per hour
pCi - picocurie
pCi/g - picocurie per gram
pCi/100 cm^2 - picocurie per one hundred square centimeters
$T_{½}$ - radioactive half-life

BUMED - Bureau of Medicine and Surgery
CFR - Code of Federal Regulations
CNO - Chief of Naval Operations
DRMO - Defense Reutilization and Marketing Office
DON - Department of Navy
EPA - Environmental Protection Agency
G-RAM - general radioactive material
IM-247/PD - beta-gamma survey meter
IM-253/PD - gamma scintillation survey equipment

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

LLRW - low level radioactive waste
MARSSIM - Multi-Agency Radiation Survey and Site Investigation Manual
MDA - minimum detectable activity
NaI(Tl) - sodium iodide with thallium (crystal)
NSN - National Stock Number
NAVRAMP - Navy Radon Assessment and Mitigation Program
NARM - naturally-occurring and accelerator-produced radioactive material
NAVSEADET RASO - Naval Sea Systems Command Detachment, Radiological Affairs Support Office (RASO, SEA 07R1)
NIST - National Institute of Standards and Technology
NNPP - Naval Nuclear Propulsion Program
NORM - naturally-occurring radioactive material
NRC - Nuclear Regulatory Commission
NRMP - Navy Radioactive Materials Permit
NRSC - Navy Radiation Safety Committee
NWRCP - Nuclear Weapons Radiological Controls Program
RAD-010 - S0420-AA-RAD-010, Radiological Affairs Support Program Manual
RADIAC - radiation, detection, indicating and computation instrument
RASP - Radiological Affairs Support Program
S0420-AA-RAD-010 - Radiological Affairs Support Program Manual (RAD-010)
SEA 07R1 - Naval Sea Systems Command Detachment, Radiological Affairs Support Office (NAVSEADET RASO, RASO)
SODIVNAVFACENGCOM - Southern Division Naval Facilities Engineering Command