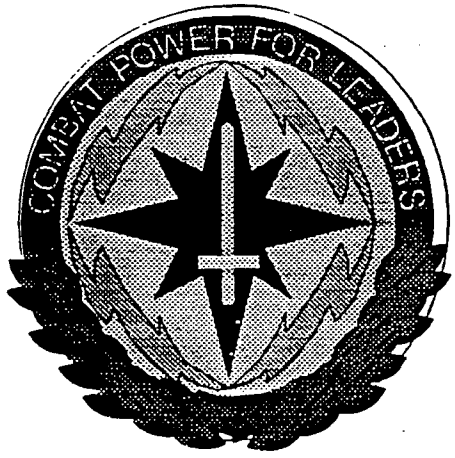
RADIOLOGICAL CHARACTERIZATION PLAN

Camp Evans, Fort Monmouth

Prepared for

U.S. Army Communications - Electronics Command
Fort Monmouth, New Jersey



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RADIOLOGICAL CHARACTERIZATION PLAN

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Executive Summary

The Evans Area is located in Wall Township, Monmouth County, NJ approximately ten miles south of Fort Monmouth main post. The Evans Area consists of laboratories, field test areas and ancillary service buildings devoted to research and development of electronic and optical systems for Department of the Army (DA) use.

Base Realignment and Closure (BRAC), Army Execution Plan, BRAC 93, (Public Law 101-510) requires the U.S. Army Communications-Electronics Command (CECOM) and Fort Monmouth, NJ, to close the Evans Area sub-post by September 1997. The CECOM Safety Office is tasked to radiologically decommission the property and provide for its release for unrestricted use. This includes termination of Nuclear Regulatory Commission (NRC) License #29-01022-07 and #29-01022-10. It also includes "end-of-use" surveys for NRC Licenses #29-01022-06 and #29-01022-14. Additional details on these licenses is provided in the Introduction, Section 1.

Early in the atomic age, radioactive material was recognized as a source of power that could be utilized in electronic equipment. The Evans Area was one of the locations the Army used for radiation research in electronics. Alpha, beta, gamma, and neutron sources have been used in research at the Evans Area for almost 50 years. Radiation sources have been used in the design and development of radiation detection instrumentation for illumination of dials and switches, and to provide charged particles (alpha and beta) in the process path and electronic circuits of equipment. To support the Evans Area BRAC initiative, these past activities require that a site residual radiation study be performed to determine the magnitude of any radiation dose level, that is, the product of radioactive sources introduced to the site.

The decommissioning process consists of:

I. Historical Study
II. Scoping Surveys
III. Site Characterization
IV. Remediation (Decommissioning Plan)
V. Final Status Surveys
VI. Verification and Release for Unrestricted Use

This characterization survey plan outlines the general procedures that will be used to determine the current radiological conditions of the Evans Area. This plan incorporates the concepts of design and analysis of final status decommissioning surveys described in NUREG-1505 and related documents that are listed in Appendix A. The Base Realignment and Closure effort at Fort Monmouth is an accelerated program. The site will be surveyed in zones. When a zone satisfies release criteria, it will be released for public use. In the event that unacceptable contamination levels are found within a zone, the plan includes remediation actions that will be taken to ensure the area is remediated to satisfy regulatory compliance with the release limits for unrestricted use.

1.0 INTRODUCTION.

The U.S. Army CECOM Safety Office manages four NRC licenses that reflect the current use of radioactive material at Evans Area. These licenses are summarized in Table 1-1.

The Evans Area, a satellite of Fort Monmouth, is located in Wall Township, NJ, approximately 10 miles south of the main post. The Evans Area is approximately 215 acres in size. The area is bounded on the north by Brighton Avenue, on the east by Marconi Road and a residential development, on the south by Belmar Boulevard, and on the west by a residential development. The location and boundaries of the Evans Area are shown on Map 1 in Appendix B.

Table 1-1
Current NRC Licenses

License #	Authorized Use	Status
29-01022-06	Research and development as defined in 10 CFR 30.4; for training and instrument calibration.	License will remain ACTIVE, however, activity within the Evans Area will be terminated.
29-01022-07	For irradiation of materials except explosives and flammable materials. (437 Ci, Cs-137, Sealed) & (225 Ci, Co-60, Sealed)	To be TERMINATED by Sept 30, 1997
29-01022-10	In an underwater (pool) irradiator for the irradiation of materials except explosives, flammable, corrosives or food for human consumption. (5000 Ci, Co-60, Sealed)	To be TERMINATED by Sept 30, 1997
29-01022-14	Calibration and operational checking of radiation detection instrumentation and optical coating on thermal imaging devices.	License will remain ACTIVE, however, activity within the Evans Area will be terminated.

All areas where these licenses were/are used do not have the same potential for residual contamination. Therefore all areas will not require the same level of survey coverage to achieve a full source term[1] characterization.

Historical records and employee interviews have identified twenty-one (21) buildings and their immediate outdoor areas, two open range areas, two underground liquid waste storage tanks, four chemical neutralization tanks, and the sanitary sewer system as locations with a potential for radiological contamination. These areas with a definite

[1] SOURCE TERM: The source term consists of all residual radioactivity remaining at the site, including material released during normal operations and during inadvertent releases or accidents, and includes radioactive materials which may have been buried at the site in accordance with 10 CFR Part 20.

potential for contamination will be surveyed as affected areas[2]. All of the affected areas have been further identified as non-uniform affected areas. The remaining one-hundred-forty-seven (147) structures and all other outside areas will be evaluated, and classified as either unaffected[3] or non-impacted[4] areas. Areas with low probability of contamination are classified as unaffected areas, requiring less survey activity. Areas with no radioactive material involvement are classified as non-impacted areas not requiring survey. If during the characterization evidence is found that contradicts a locations initial classification, that location will be reclassified and appropriate surveys performed.

The level of survey to be performed in each area and building was determined by a review of site historical data. The survey data collected and analyzed during the site characterization will be capable of determining the type and quantity of residual radiation present. Areas that meet all release criteria, that can be effectively segregated from the remainder of the Evans Area, may be released for unrestricted use prior to final closure of the Evans Area. All characterization surveys that identify areas or buildings that meets the radiological release criteria will be included in the site final survey report.

If a characterization survey identifies a location with an activity level that requires remediation, the characterization survey results will be used to develop a remediation effort and, if necessary, a Decommissioning Plan with a forecast of the volume of low-level radioactive waste that will be generated during the remediation.

[2] AFFECTED AREAS: Areas that have potential radioactive contamination (based on site operating history) or known radioactive contamination (based on past or preliminary radiological surveillance).
[3] UNAFFECTED AREA: Any area that is not expected to contain any residual radioactivity, based on a knowledge of site history and previous survey information.
[4] NON-IMPACTED: Areas that have no potential for residual contamination and, therefore, do not require any level of survey coverage. Residences, mess halls, and areas off-site would typically have this classification.

2.0 SITE HISTORY.

2.1 General.

During World War I the U.S. Army purchased a tract of land in Little Silver, NJ. The land was a horse racetrack that had not been in use since 1908. On 17 June 1917, the U.S. Army inaugurated and opened the installation as Camp Little Silver. The mission of Camp Little Silver was to train Signal Corps operators for service in World War I. In 1925, Camp Little Silver became a permanent installation and was renamed Fort Monmouth.

In the early 1900's the Marconi Wireless Telegraph Company of America (MWTCA) purchased a 93 acre farm in Wall Township, NJ. This property, located approximately 10 miles south of Fort Monmouth, became the home of the Marconi Institute, a school for telegraphy. The site was also the location of wireless telegraph transmission and receiver equipment used for commercial transatlantic operations.

When the Unites States entered World War I in 1917, the federal government took over the Marconi operation in Wall Township. After the war, the government urged a consortium of American companies to buy the facility. Elements of General Electric, Westinghouse and AT&T coalesced in December of 1919 to form RCA. RCA owned the Wall Township facility until 1924, when operations were moved to more modern accommodations.

By the late 1920s, the main Marconi building had become the home of the New Jersey chapter of the Ku Klux Klan (KKK). In 1937, the property passed to a Reverend Percy Crawford, who established an interdenominational institution on the site called King's College. The school had 100 students enrolled when the government acquired the land in 1941. At that time, the site was designated Camp Evans, in honor of World War I Signal Corps officer COL Paul Wesley Evans.

When the Army bought King's College in November of 1941, it inherited six of the original Marconi buildings. These included the main Marconi building, two bungalows, the operations building, and what are now designated as Buildings 9006 and 9007. With the exception of the Marconi buildings constructed in 1914, most other construction dates to the early years of World War II, when Camp Evans was established. The mission at the Evans Area during and immediately following World War II was Research and Development (R&D) of radar technology. In 1951, the Evans Area R&D organizations began experiments that used radioactive material.

2.2 Nuclear.

Use of radioactive materials in the Evans Area began in 1951 at the Evans Signal Laboratory. Isotopes used in the 1950's included unsealed cobalt-60 (Co-60), polonium-210 (Po-210) and radium-226 (Ra-226) that was used to manufacture self-

luminous strips. In 1952, the Radiation Effects Laboratory (REL) was built and placed in operation. The REL was needed to satisfy the specialized shielding needs of ionizing radiation research. The REL is active today and a variety of radioactive sources are still used and stored there.

2.3 Historical Review.

Past and present Evans Area radiation workers were interviewed to obtain historical information on sites of potential contamination. Appendix C contains a copy of the questionnaire used to conduct the interviews and a list of the individuals interviewed. Several employees that had started working at the Evans Area during World War II were available for interview. Based upon the interviews, a historical document review and on-site evaluations, the buildings and areas listed in Table 2-1 are identified as affected areas. All other buildings and areas are classified as unaffected or non-impacted.

2.4 Historical Findings Brief.

The following outline of findings, from historical information, on buildings and areas explains why the locations listed in Table 2-1 were identified as locations with a potential for contamination from the use of radioactive material. These buildings with their locations are listed in Appendix D.

BUILDING 9045

An incident report written in 1962 describes strontium-90 (Sr-90) and Co-60 contamination incidents in this building. Written reports indicate that the clean-up effort was extensive requiring the removal of sink and floor drain pipes, laboratory equipment, concrete, and a portion of the building. The clean-up criteria used was 0.1 milli-roentgen equivalent man per hour (mrem/hr) for fixed activity and 10 counts per minute (cpm) per wipe removable contamination. These reports provided no information on the types of instruments or the efficiency of the instruments used for these surveys. The clean-up report states that in some areas contamination was not reduced to the selected clean-up criteria limits (0.1 mrem/hr fixed activity and 10 cpm per wipe removable activity).

Building 9045 has undergone renovation since 1962 that has changed the original floor plan. In February 1995, while researching the original floor plan layout, an area with a history of contamination in the building was identified. The area was surveyed with a thin-window G-M tube (pancake detector) and residual radioactivity greater than twice background levels was detected.

Employees interviews indicate that there may have been rubidium-87 (Rb-87) present in some equipment which was burned outside this building in the early 1950's. Therefore, there is a potential for Rb-87 contamination in the soil surrounding this building.

The building is currently in use as a radiation counting laboratory and a radiation survey instrument repair and calibration facility. A radioactive materials storage cabinet, with several low level radiation sources, is still in the building.

Table 2-1
Affected Areas

Location	INTERIOR Square Meters to be Surveyed	EXTERIOR Number of Survey locations
bldg 9045*	1600	120
bldg 9383*	100	80
bldg 9401*	2000	160
Area G	n/a	3966
bldg 9006	823	100
bldg 9010A	2200	400
bldg 9011A	2200	400
bldg 9032	2200	400
bldg 9036	4400	400
bldg 9037	4400	200
bldg 9039	5000	240
bldg 9040	3500	200
bldg 9041	3500	180
bldg 9047	1600	120
bldg 9049	1000	120
bldg 9053	40	160
bldg 9055	1600	160
bldg 9109	600	120
bldg 9345	2000	200
bldg 9392	900	160
bldg 9400	600	100

* These buildings and the fenced area they are located in are still radioactive material use, handling and storage facilities.

BUILDING 9383

This building was built in the 1950's to store radioactive waste. Survey documents show the soil around this building was contaminated with Co-60 in the 1970's. Survey reports show that the decontamination operation was successful and the contaminated soil was disposed of at Barnwell, SC, radioactive waste landfill.

This building is still in service as the radioactive waste storage site for all of Fort Monmouth.

BUILDING 9401

This building is the Radiation Research Facility (RRF) of the REL. Employee interviews indicated unsealed radioactive sources were used in this building. They also described localized contamination incidents that occurred in the building. The employees stated that the contaminated areas were always decontaminated to levels less than U.S. Army contamination limits listed in Army Regulation 385-11.

The RRF currently contains several sealed radioactive sources and a neutron generator that are used for research and radiation detection instrument calibrations. NRC Licenses 29-01022-07 and 29-01022-10, authorize the use of Co-60 and Cs-137 sources for irradiation of materials; these licenses are current and still used in the RRF. Also, isotopes listed on NRC Licenses 29-01022-06 and 29-01022-14 for calibration, operational checking, optical coating on thermal imaging devices and research and development, as defined in 10 CFR 30.4, are or may be used in the RRF.

AREA G

During the 1950's and early 1960's, Area "G" was the site of experiments using sealed Co-60 sources. This site is an open field with some wooded areas, secured by cyclone fence topped with barbed wire that encloses all of the southern portion of the Evans Area. Documents show that during the experiments, two locations were contaminated by leaking sources. The areas were cordoned-off with ropes and posted with caution signs that identified them as radioactive contaminated areas. Since the contamination occurred in the secure area of the site, no other actions were taken at that time. In 1963 the experiments were completed. There is no record of any use of radioactive sources in "G" Area after that time.

In 1976 workers clearing brush found radiation warning signs posted in "G" Area; work was halted and the CECOM Safety Office was notified. Initial survey results revealed the presence of radioactive contamination that was identified by gamma spectroscopy analysis as Co-60. The CECOM Safety Office requested the assistance of the US Army Environmental Hygiene Agency (AEHA), Aberdeen Proving Ground,

MD to conduct scoping, remediation, and verification surveys of the area. The scoping survey defined the region of contamination, and remediation surveys monitored the progress of the clean-up effort. The highest concentration of Co-60 found in the soil was 395.0 ± 12.7 picocuries per gram (pCi/g). Two pieces of plastic (removed as radiological waste) were contaminated with Co-60 to 6924.0 ± 99.0 pCi/g. Vegetation in the area was found with concentrations as high as 149.2 ± 7.8 pCi/g. The decontamination required the removal of soil in the immediate area down to a depth of 5 feet and removal of vegetation. The radioactive waste generated was collected in fifty-five gallon metal drums. A total of five-hundred-sixty-eight (568) drums were filled. The drums of waste were shipped off-site and disposed of at Barnwell, SC, radioactive waste landfill.

In November 1976, AEHA conducted a verification survey of the contaminated site. The area was surveyed at ground level for external radiation dose rates. Background in the region was 12 microroentgen per hour (uR/hr), no area was greater than twice background. Two soil bore samples were collected. The highest activity detected in the soil was 6.5 ± 1.6 pCi/g of Co-60. Based on the verification survey results the area was released for unrestricted use.

In March 1983, a brush clearing crew found radiation warning signs and a barrier rope around a concrete block structure (30" x 30" x 48") in the "G" Area; work was stopped and the CECOM Safety Office was notified. A radiation survey of the area revealed the presence of contamination that was identified by laboratory analysis as Co-60. This contaminated structure was approximately 100 feet from the border of the first contamination found in the "G" Area and, for report purposes, was designated "G-2". The highest Co-60 concentration in the soil against the bottom blocks was 21 pCi/g. Seven inches away from the base of the structure the highest concentration was 7 pCi/g. The contaminated soil and concrete was collected in fifty-five gallon metal drums and shipped to the Barnwell, SC, radioactive waste landfill.

AEHA performed verification surveys of the "G-2" Area in April 1983. Based on the results of the survey the area was released for unrestricted use. A second verification survey was performed by AEHA in June 1985 and this survey confirmed the results of the pervious verification survey.

Remaining Affected Historical Buildings.

The historical records search and employee interviews identified the other buildings listed in Table 2-1 as radioactive material use areas. These buildings all had recorded periods of use, storage, and/or maintenance of radioactive materials. The activities in these buildings included research and development projects that used radioactive materials.

Underground Storage Tanks.

Two underground storage tanks are located adjacent to building 9045. The purpose of these tanks is to collect water from the laboratory and decontamination room drains in building 9045. Another influent to the tanks is the discharge line from the Co-60 pool irradiator in the RRF. The tanks are alternately connected to these drains. When a tank is full it is valved out-of-service and the building and pool drains are valved to the other tank. Prior to release into the sewer system the water collected in a tank is analyzed for contamination. A water sample is taken from the tank that has been valved out-of-service. The sample is analyzed for radioactive isotopes prior to release of the tank's contents. The analyses of the tanks' contents is a license requirement for the Co-60 pool irradiator. The purpose of the analyses is to ensure that no contaminated water is released.

When all radioactive sources are removed from the pool irradiator and building 9045, these tanks will be surveyed as affected areas in preparation for removal.

Underground Neutralization Tanks.

The Evans Area had four underground neutralization tanks. These tanks were located outside of closed chemistry laboratories. The contents of these tanks, the pits they occupied and the surrounding soil, were sampled for radioactive contamination in preparation for removal. The samples were analyzed for contamination from gamma, alpha and beta emitters. The analysis results revealed no radioactive contamination. The tanks have been declared free of radioactive contamination and released for removal.

Three more underground storage tanks have been identified at the Evans Area since the four neutralization tanks were removed. All underground tanks will be characterized to determine if they were involved in radioactive material use.

Sanitary Sewers.

Prior to 1950, there were no sanitary sewer radioactive material release limits. When regulated limits were established in the 1950's, they were very liberal in comparison to current limits. The dumping of small quantities of radioactive isotopes into the sewers was an accepted practice during this period. For these reasons and due to the wide spread use of radioactive material throughout the Evans Area, the sanitary sewers have been classified as affected.

Unaffected Areas and Non-impacted Areas.

The remaining operation areas have no history of radioactive material use (indoor and outdoor). They will be surveyed as unaffected areas. The buildings at Evans Area

with no operations history, and the immediate area around these buildings (administrative, residence, utilities, shelters, etc.), have been identified as non-impacted areas. No characterization surveys will be performed in these buildings. However, each building will be evaluated. Some non-impacted buildings in the Evans Area may be used as reference areas[1]. All of the Evans Area buildings are listed in Appendix E.

[1] **Reference Area:** Geographical area from which representative reference samples will be collected for comparison with samples collected in geographically similar surveyed areas at the remediated site.

3.0 GOALS.

3.1 Objectives.

The characterization survey will assess the current radiological condition of the Evans Area. The surveys and analysis of results will be performed quantitatively and qualitatively with a precision that will satisfy the release criteria described in paragraph 3.2 of this chapter. This will allow characterization survey results for a building or area that is below release limits to be used in the Final Status Survey Report. The survey and results analysis will be designed to satisfy requirements outlined in NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys".

3.2 Release Criteria.

The NRC and New Jersey Department of Environmental Protection (NJDEP), Bureau of Environmental Radiation release criteria are currently being revised and draft regulations for both agencies are in the review process. The release criteria that will be used in the final survey report, for the Evans Area, is that proposed in draft NRC regulation, Title 10, Code of Federal Regulations, Part 20, Subpart E. The draft regulation specifies that radioactivity from licensed operations be reduced to a level as-low-as-is-reasonably-achievable (ALARA) below the level that would result in a 15 millirem per year (mrem/yr) dose to the average individual in the critical group. This release criteria satisfies purposed New Jersey State release limits detailed in the New Jersey Department of Environmental Protection Draft Report for Comment, "A Pathway Analysis Approach for Determining Generic Cleanup Standards for Radioactive Materials", January 1996. The same release criteria will be applied to naturally occurring radioactive materials that have been concentrated for use, i.e., Ra-226 in illuminating paints, Th-232, Depleted Uranium, etc.

Survey results that indicate a zone's annual dose from residual radiation is less than or equal to 4 mrem, will require no ALARA evaluation.

Surface Contamination.

Table 3-1 lists all isotopes that were authorized for use in the Evans Area by NRC licenses. One of the NRC licenses for the Evans Area was a general license. The NRC general license authorizes use of any byproduct isotope with atomic number 1 through 83; in fact the number of different isotopes used in the Evans Area was limited. Surface contamination surveys will focus on the detection of isotopes that were known to be used in an area. Table 3-2 provides default concentration values taken from NUREG-1505 that are equivalent to 15 milli-roentgen equivalent per year for each area use scenario. Surface contamination, not removable by simple

decontamination procedures, that exceeds the values listed in Table 3-3[a], will require a written decommissioning plan for the area.

Drinking Water.

If contamination is found in ground water wells, the potential impact on drinking water supplies will be evaluated. Based on the historical review, no ground water contamination is anticipated.

Soil.

The concentration of radioactive materials in the soil will be compared to the Residential Scenario models found in NUREG/CR-5512, Volume 1, using the default parameter values listed. The concentrations for all isotopes for the Residential Scenario which produce a 15 mrem/yr Total Effective Dose Equivalent (TEDE) are listed in NUREG-1500.

For some isotopes, the NRC and Environmental Protection Agency (EPA) have approved some isotope concentrations which exceed the default values listed in NUREG-1500. Table 3-4 lists the concentrations from NUREG 1500. The values in parentheses on Table 3-4 are approved values that exceed the NUREG-1500 concentrations. These values were taken from the following sources, Federal Register/Vol. 57, No. 34/ Thursday, February 20, 1992/Notices, and Federal Register/Vol. 46, No. 205/Friday, October 23, 1981/Notices.

[a] Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material, April 1993, U.S. Nuclear Regulatory Commission Division of Fuel Cycle, Medical, Academic and Commercial Use Safety.

Table 3-1
List of Isotopes

ISOTOPE	CHEMICAL/PHYSICAL FORM
Any Byproduct Material with Atomic Number 1-83	Any
Tritium	Any
Cobalt 60	Any
Krypton 85	Any
Rubidium 87	Any
Strontium 90	Any
Cesium 137	Any
Polonium 210	Any
Thorium 234	Any
Thorium 230	Electroplated
Thorium 232	Metal foils, solid (thorium fluoride coating on optical systems)
Plutonium 238	Sealed
Plutonium 239	Electroplated, resin on acrylic plastic disk
Uranium (natural or depleted)	Any
Americium 241	Any
Californium 252	Sealed
Radium 226	Any
Ra-Be	Sealed

Table 3-2
Default Concentration Values to Achieve 15 mrem/y for Each Scenario

Decay Chain	Soil Concentration Residential Scenario (pCi/g)	Surface Concentration Building Occupancy (dpm/100cm^2)	Volume Concentration Renovation Scenario (pCi/g)	Source Term Drinking Water Scenario (total pCi)	Soil Concentration Drinking Water Scenario (pCi/g)
H-3	4.14E+02	2.64E+07	4.66E+07	1.21E+11	9.76E+02
Co-60	2.97E+00	5.19E+03	1.94E+01	1.32E+12	1.07E+04
Sr-90	1.14E+01	9.94E+03	6.96E+03	4.85E+09	3.92E+01
Ra-226	7.87E-01	7.57E+02	2.71E+01	7.83E+08	6.34E+00

Table 3-3
Acceptable Surface Contamination Levels

Nuclide[b]	Average[cdf]	Maximum[bef]	Removable[bfg]
U-nat, U-235, U-238, and associated decay products	5000 dpm α/100cm^2	15000 dpm α/100cm^2	1000 dpm α/100cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm /100cm^2	300 dpm /100cm^2	20 dpm /100cm^2
Th-nat, Th-232, Sr-90, Ra-232, Ta-224, U-232, I-126, I-131, I-133	1000 dpm /100cm^2	3000 dpm /100cm^2	200 dpm /100cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission except Sr-90 and others noted above)	5000 dpm $\beta\gamma$/100cm^2	15000 dpm $\beta\gamma$/100cm^2	1000 dpm $\beta\gamma$/100cm^2

[b] Where surface contamination by both alpha and beta-gamma emitting nuclide exists, the limits established for alpha and beta-gamma emitting nuclide should apply independently.

[c] As used in this table, dpm (disintergrations 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.

[d] 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 such object.

[e] The maximum contamination level applies to an area of not more than 100cm^2.

[f] The amount of removable radioactive material per 100cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying 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.

[g] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

Table 3-4
Unrestricted Soil Concentrations

ISOTOPE	Soil Concentration @ 15 mrem/yr Residential Scenario (pCi/g)	ISOTOPE	Soil Concentration @ 15 mrem/yr Residential Scenario (pCi/g)
H-3	4.14E+02	Pu-238	2.10E+00 (25.0)[1]
Co-60	2.97E+00 (8.0)	Pu-239	1.89E+00 (25.0)
Sr-90	1.14E+01 (5)	U-234	1.90E+01
Cs-137	1.07E+01 (15.0)	U-235	1.49E+01
Pu-210	1.10E+01	U-238	1.97E+01 (35.0)
Th-234	2.93E+03	Am-241	1.83E+00 (30.0)
Th-230	2.61E+00	Cf-252	6.53E+00
Th-232	8.71E-01	Ra-226-C	5.62E+00

[1] The values in parentheses are approved values that exceed the NUREG-1500 concentrations.

4.0 ACTIVITIES.

4.1 General.

This section describes the overall plan to accomplish the radiological characterization of the Evans Area of Fort Monmouth. General sequences and descriptions of activities for different areas are contained in this section. The planned survey activities are based on historical document reviews and personnel interviews. The decommissioning operations and quality assurance activities will be conducted in accordance with procedures approved by the Program Manager and Radiation Protection Officer.

This plan will assess and evaluate the levels of residual radioactive material that remain at the site as a result of the use of licensed radioactive material and the concentration of natural occurring radioactive isotopes.

Based on inspections and the historical review that identified known contamination locations and other radioactive material use, storage, and maintenance operations, the facilities undergoing characterization have been placed in one of five categories.

1) Indoor Affected Areas
2) Indoor Unaffected Areas
3) Outdoor Affected Areas
4) Outdoor Unaffected Areas
5) Non-impacted

The Evans Area has been divided into six survey zones. These zones allow for portions of the property to be surveyed and scheduled for early release. The six zones are outlined on Map 2 located in Appendix B. Appendix D contains photographs for the affected buildings and gives their locations.

The zones are separated by roads, fences or other easily identified geographical features. Since the zones are separated they will be treated as independent projects. When a zone's surveys have been completed, data analysis shows all release criteria are satisfied and regulatory agencies approve, the zone may be released for private use. This survey approach will allow property release to the public at the earliest possible time while ensuring release criteria are achieved.

In conjunction with zone surveys, reference (background) surveys will be conducted in a physically similar non-impacted area. Areas within a zone, which are classified as affected, will be gridded in a triangular pattern that will produce adequate data collection for statistical analysis. The location of each data collection point will be recorded with a precision that will allow, if needed, verification data collection in the

area of the point at a later date. All samples and data collected will be analyzed for release criteria compliance. The final results will be compiled into a zone final survey report which will be used to release the zone. The zone reports will become the body of the final site survey report.

4.2 Reference (Background) Data.

Reference data is essential to the release survey process. Reference radiation concentrations are the levels of radiation present in a non-impacted area that is physically similar to the area in which survey data will be collected. When required the radioactive material concentrations in water, soil, and building materials will also be addressed in the reference studies.

Reference data will be collected in a location that has spatial and temporal relations similar to the area to be surveyed. An example would be the collection of reference data in a brick building that was non-impacted to compare with survey data taken in an affected brick building located in the survey area. The data collection in the reference area and the survey area will be taken with the same materials and instruments. The number of samples collected in the reference area will be large enough to provide a statistical analysis of the survey sample population.

Data collection in the reference and survey area will occur within the same time period. Any outside events (atmospheric nuclear weapons tests, volcanic eruption, etc.) that impact the region's (Monmouth County) residual radioactive characteristics, will require new reference data to be collected for comparison with any survey data collect after the event.

Reference locations will be selected from non-impacted areas located in the Charles Wood Area, Evans Area and Fort Monmouth main post. A reference area may be used for comparison to several sets of survey data as long as the physical, spatial and temporal conditions are similar. Reference areas will be accurately described and located so that verification data can be collected.

4.3 Gridding.

A reference grid system will be used in affected areas in order to provide a location code for each data/sample location. The location code will enable verification data to be collected at the original survey data locations. Each indoor affected area will be gridded in an equilateral triangle pattern. The side of the triangle will be a minimum of one meter in length but can be larger if survey parameters indicate that any potential contamination can be detected with a greater (more distance between data points) sampling interval. Triangle grid patterns that are performed with triangle sides that are greater than one meter, will have the data used to determine the sampling interval

attached to the survey information page. Outdoor affected areas will be gridded using the same methods, but the minimum triangle side will be five meters in length.

Indoor unaffected areas will not require gridding. The floor plan of the surveyed area will be marked at each data/sample point with sufficient information to accurately return to the point. This location data will be used if verification surveys are performed in any area.

Outdoor unaffected areas will be gridded with a triangle grid side of twenty-five meters long. Outdoor unaffected areas are gridded for accurate location of data points due to the lack of structured bench marks.

All outdoor gridding start points will be selected randomly. The random selection is performed using a random number generator software program that generates three digit random numbers. The random numbers are used to develop map coordinates in the area. The map coordinates are entered on a survey map and into a Global Positioning System (GPS) that is used to locate the point in the field. The grid is laid using land survey instruments. If the terrain or ground cover vegetation makes land survey impractical in an unaffected area, sample points will be located by GPS.

4.4 Survey Procedures.

Each survey in a zone will have a sampling plan and survey packets prepared prior to the performance of the survey. The packet will include:

1) Survey maps (structural and grids)
2) List of required samples and instrument readings
3) Sampling location codes (hard copy or electronic)
4) Work permit, if required

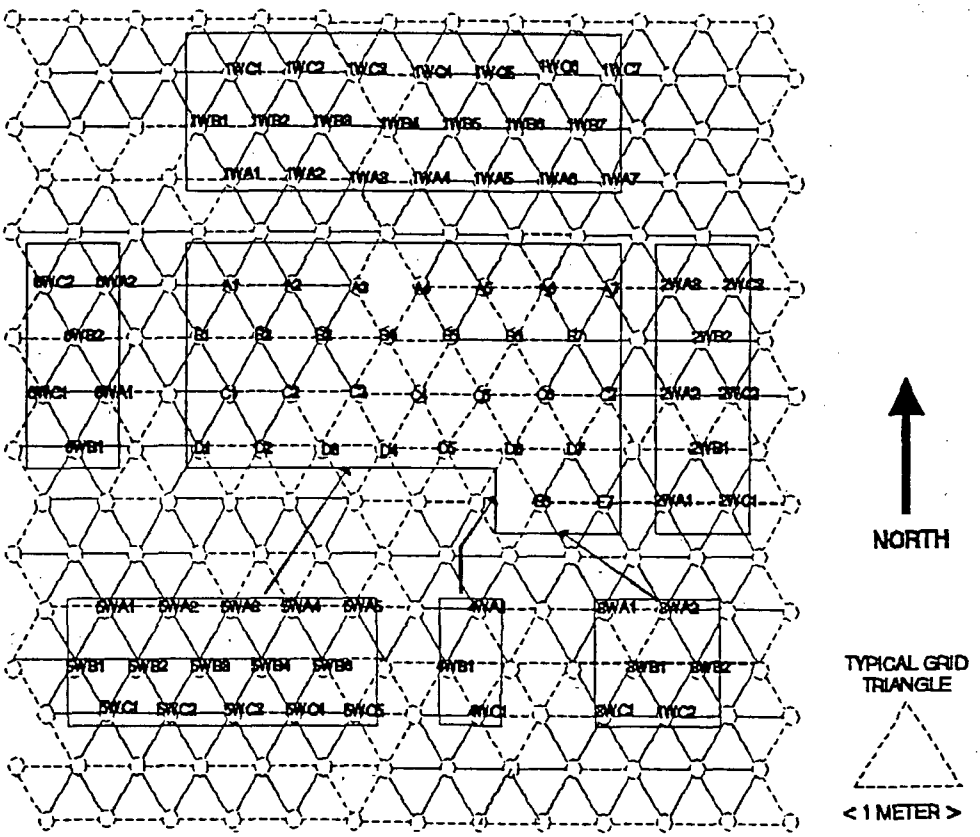
INDOOR AFFECTED AREAS.

Prior to the start of any work in an affected area, the area boundaries will be defined and any required administrative controls implemented. All indoor affected areas will be evaluated prior to the start of work by a senior health physics (SHP) technician for potential safety hazards. The area will be secured and, if required, a work permit posted at the entrance to the area. The work permit will identify any industrial and radiological hazards, list special instructions, any contamination control procedures and protective clothing and/or equipment that may be required for entry. It will also contain emergency phone numbers and any special procedures for the area. Areas that require a work permit will have all items that are removed from the area wiped and then scanned with an instrument prior to removal from the area. Items identified as contaminated will be held for decontamination or disposal. If the area does not require

a work permit for entry, the project manager will notify the survey team's SHP Technician to start work and note that decision on the survey form.

The area will be gridded in accordance with survey procedures. The grid system will be further defined in the survey packet for each area. The sample locations will be labeled alpha-numerically. The floor rows are alphabetically labeled (most northern is "A") and the columns (most westerly is "1") are numerically designated. Figure 4-1 provides an example of the indoor affected area gridding system. It shows the alpha numeric designator for each grid. The sample location code uses this designator in the samples identification code.

FIGURE 4-1
TYPICAL AFFECTED ROOM GRID PATTERN



One hundred percent of the surface area will be scanned for contamination using appropriate instruments. If contamination is found, the boundary of the contamination will be determined. It is also necessary to determine if the contamination is removable or fixed. If the contamination is fixed the extent of leaching into the subsurface must be determined. When survey instruments indicate an area of elevated activity, a wipe will be collected at the point and analyzed for type and quantity of removable contamination. When scanning results are negative, fixed readings will be recorded following the triangle pattern (Figure 4-2). The three corners of the triangle pattern will be the data points of the survey. If no contamination is found above the release criteria, the area will be posted to identify it as prepared for release and restricted from further introduction or use of radioactive materials.

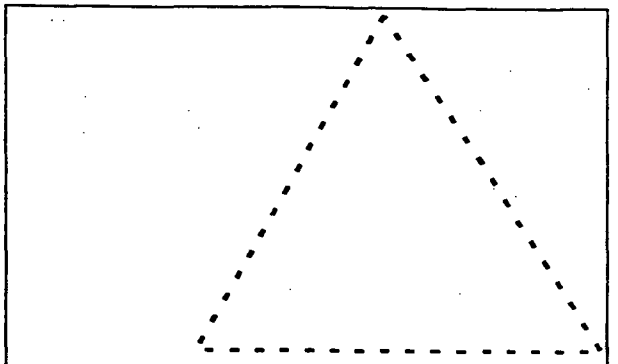


Figure 4-2: Samples and measurements taken at triangle corners.

Along with survey instrument readings, the removable contamination in all areas will be assessed. If required, both a wipe for liquid scintillation analysis and a wipe for gross alpha/beta counting will be taken from the triangle points of each grid. If an instrument reading in a grid is higher than the action level, of two times daily QA check background reading for the instrument (i.e. background 40 cpm beta, scan reading 80 cpm beta) a wipe for gross alpha/beta will be collected from that location as well. If counting results determined the activity is fixed, the location will be further evaluated to determine if a grab sample will be collected. A grab sample is a physical sample of building material, soil or ground cover material which appears to be the cause of the elevated instrument readings.

Each area will have its own sampling requirements. These requirements will be outlined in the individual survey packets for the area.

INDOOR UNAFFECTED AREAS.

These areas are not expected to be contaminated. No work permit is required for these areas. Gridding is not required for reproduction of the survey data.. The survey teams will be provided with building floor plans. The sample locations will be marked on the map. When needed a brief description of the sample location may be included on the data sheet.

Only two unaffected buildings, 9011 and 9043, have more than 1500m^2 surface area. These buildings require 60 random sample locations and a 10% surface scan. In the remaining unaffected buildings, a minimum 10% surface scan and 30 random sampling

locations will be surveyed. In addition, any drains, vents, and fume hoods will be surveyed. If residual radioactivity is found that exceeds 70 percent of the release guidelines, then the areas classification will be changed to affected area and the sampling plan adjusted. If gamma activity, when averaged over $10m^2$, is 5 uR/hr or greater than background, then the area will be reclassified as affected.

At each sample location alpha and beta-gamma surface measurements will be taken. A gamma exposure measurement will be taken at one meter from each sample point. A liquid scintillation and a gross alpha/beta wipe will also be collected at each sample point.

OUTDOOR AFFECTED AREAS.

These areas have not been used since the 1960's for research involving radioactive material. All known incidents of contamination in these areas have been remediated. If any residual radioactive material is still present the quantities are expected to be small. For these reasons, surveyors will not be required to wear anti-contamination protective clothing when performing these surveys. If contamination is detected, work permits and control procedures will be initiated and the boundary of the area posted with an entry/exit point.

One hundred percent of the surface area will be scanned for gamma radiation. Any location where activity is detected that is greater than 70% of the guidelines for gamma exposure, will be marked and a soil sample will be collected. Soil release limits for some isotopes that will be considered are less than the detectable limits for the portable survey instruments being used for scanning. Therefore, the area's characterization will be based upon the collection of soil samples and laboratory analysis of the samples.

Affected areas will be gridded with an equilateral triangle pattern with 5 meter or greater sides. Grid sides greater than 5 meters will be justified by performing calculations discussed in NUREG-1505, paragraph 5.5.4, Probability of Detecting an Area of Elevated Activity. The sample points of the grid are the three corners of the triangle pattern. Figure 4-3 is an example of a gridded affected outdoor survey area. It represents the survey grid system that will be used in Area G.

Other media, such as surface water, vegetation, etc., may require sampling due to the composition of the area being surveyed. The need for other samples will be evaluated on a case-by-case basis. Each area will have its own sampling requirements. These requirements are outlined in the individual survey packets for each location.

OUTDOOR UNAFFECTED AREAS.

No work permit will be required in these areas. These areas are assumed to have no contamination present based on historical data. Unaffected areas do not require gridding to select sample point. However, large areas will be gridded to ensure adequate samples are taken to justify the release decision for the area. When used, the grid pattern will be an equilateral triangle pattern with sides 25 meters in length. Typically a soil sample and gamma dose rate reading will be taken at each sample point.

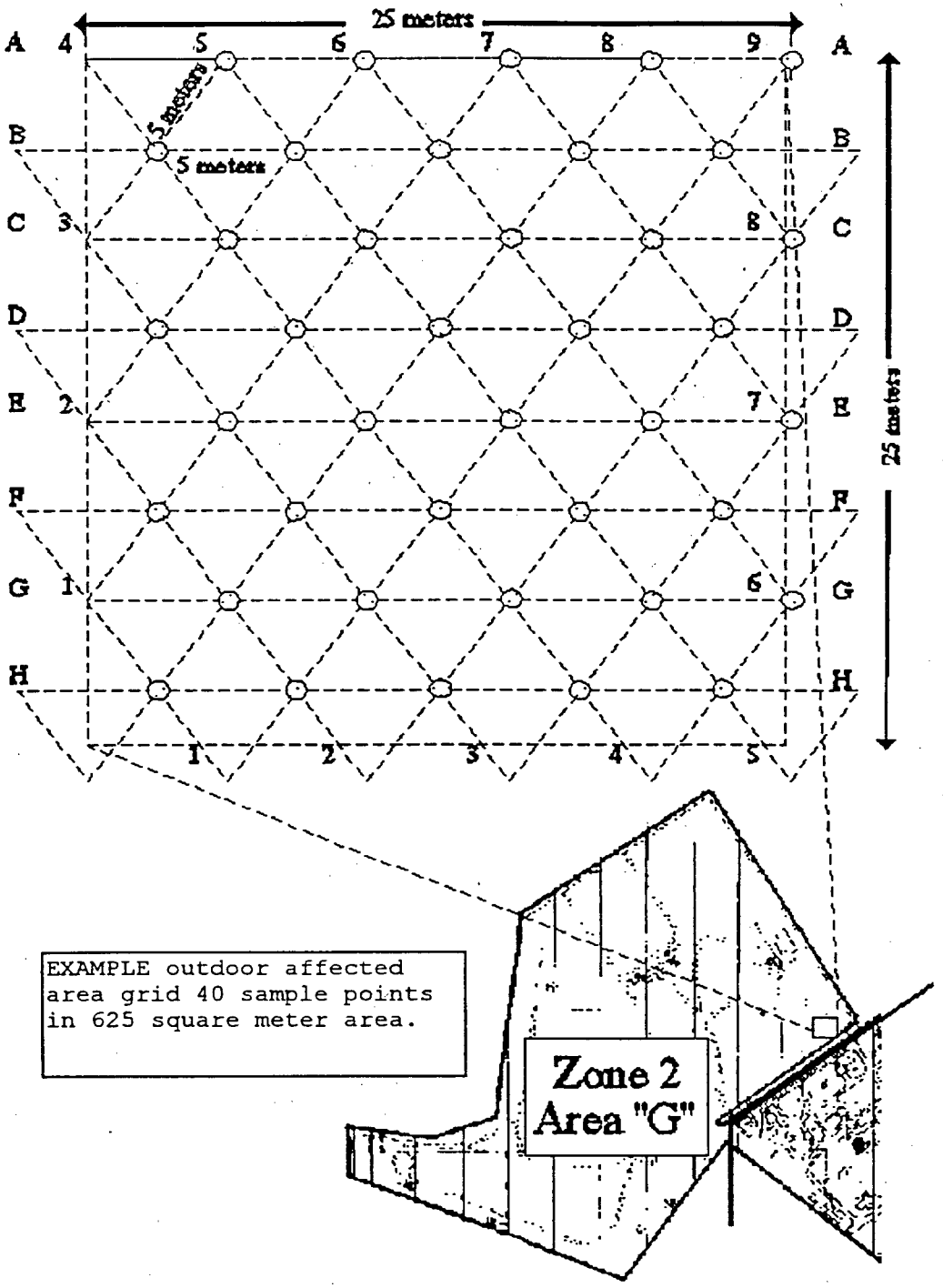
Release limit concentrations for some isotopes are below the Minimum Detectable Activity of available scanning instruments. The characterization of the area will be based on the analysis of physical samples collected. However, scanning will still be conducted in these areas to verify that no elevated activity areas are present. In unaffected areas, a minimum of 1% of the surface will be scanned.

For areas of less than 20,000 square meters sampling will be performed at a minimum of 30 randomly selected locations. In addition to randomly selected locations, samples will also be collected where past geophysics reports have identified anomalies (i.e., landfills, dumps established after 1950).

MANHOLES.

The sewers may have been affected by historical work conducted at the Evans Area. Each manhole will be entered and the vertical shaft and immediate sewer tunnel will be characterized. Each manhole entry will be a confined space entry, and safety procedures for confined spaces will be followed for each entry.

Figure 4-3
Example Outdoor Affected Grid System
"AREA - G"



There are 47 manholes through-out the Evans Area. Lines will be drawn on the vertical shaft walls in the due east and westerly directions. This divides the manhole shaft into north and south walls. The north and south shaft walls will be divided into one meter vertical grids and the sewer tunnel floor (shaft bottom) will be a grid. (See Figure 4-4)

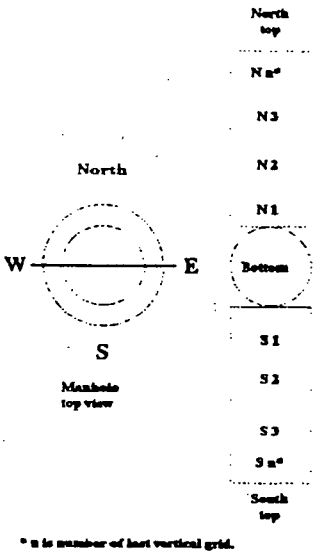


Figure 4-4

Each manhole tunnel floor grid will have two sediment and, if possible, two water samples collected. The shaft wall grid surfaces will be surveyed following the same protocols as an indoor affected area.

UNDERGROUND STORAGE TANKS.

There are two underground storage tanks located next to building 9045. The contents of the tanks will be sampled for alpha, beta and gamma activity. Other underground storage tanks in the area that were laboratory discharge line tanks will be surveyed for radioactive contamination. The soil above and on all sides of these tanks will be sampled before any excavation begins. If no contamination is found the soil will be excavated and the storage tanks removed. After the tanks are removed the area under the tanks will be sampled. If no contamination is detected the hole will be filled.

UNDERGROUND NEUTRALIZATION TANKS.

Four underground neutralization tanks were identified in the historical review of the Evans Area. These tanks were located outside of closed chemistry laboratories in the Evans Area. The contents of the tanks were known to contain hazardous liquid waste. The EPA requires the prompt disposal of hazardous waste once identified. To satisfy the EPA prompt disposal requirement, the contents of these tanks, the pits they occupied and the surrounding soil, were sampled for radioactive contamination in preparation for removal. The samples were analyzed for contamination from gamma, alpha and beta emitters. The analysis of the contents of the four tanks verified that there was no radioactive

contamination in the tanks. The tank contents were disposed of as hazardous waste. The soil samples collected and analyzed showed the tanks were free of external radioactive contamination and they are released for disposal.

5.0 SCHEDULE.

The decommissioning process consists of the following activities.

I. Historical Study
II. Scoping Surveys
III. Site Characterization
IV. Remediation (D-Plan)
V. Final Status Surveys
VI. Verification and Release for Unrestricted Use

The characterization phase of the decommissioning process is composed of the following sub-phases. The following schedule (page 5-2) is a tentative timeline contingent primarily upon the movement of personnel from the Evans Area. Buildings must be vacated with no future operations scheduled prior to survey.

Table 5-1
Timeline of Events

I. Background Study ..... September 1995
II. Site Preparation ..... May 1996 - July 1996
III. Surveying ..... August 1996 - September 1997
IV. Sample Analysis ..... August 1996 - October 1997
V. Initial Draft Characterization Report and Decommissioning Plan ..... January 1997
VI. Final Draft Characterization Report and Decommissioning Plan ..... August 1997
VII. Characterization Report and Decommissioning Plan complete..... September 1997
VIII. Remediation/Decommissioning ..... January 1997 - January 1998

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