DEPARTMENT OF THE ARMY
WALTER REED ARMY MEDICAL CENTER
WALTER REED HEALTH CARE SYSTEM
WASHINGTON, DC 20307-5001

REPLY TO
ATTENTION OF

MCHL-HP (385-11p) 8 June 1999

MEMORANDUM FOR Commander, Walter Reed Army Institute of Research, Washington, DC 20307

SUBJECT: Decommissioning of Building 506, Forest Glen Section, Silver Springs, Maryland

1. REFERENCES. See Appendix A for a list of references.

2. PURPOSE.

a. The Nuclear Regulatory Commission (NRC) requires the radiological decommissioning of sites, buildings and outdoor areas where licensed activities have ceased radiological operations, even while licensed activities continue to be conducted at other site locations. The criteria to decommission a building is when: (1) the licensee has decided to permanently cease principal activities; or (2) no principal activities have been conducted in such an area for a period of 24 months. Radiological activities from authorization 650 concluded in February 1999, and there is no planned further planned use of radioactive materials in this building.

b. The Nuclear Regulatory Commission Region I has been notified of the proposed decommissioning of building 506 in a letter to the Division of Nuclear Material Safety dated 14 January 1998.

c. This survey was conducted to determine the presence and extent of any radiological health hazards in Building 506, Silver Springs, Maryland. This survey also verified that any remaining residual radioactivity in the building surveyed is in compliance with the NRC and State of Maryland guidelines for the decontamination of facilities prior to release for unrestricted use.

3. GENERAL.

a. Planning Phase. This survey is designed and developed using the Data Quality Objectives (DQO) Process.

(1) Problem. This survey will determine the presence and extent of any radiological health hazards in Building 506,

Forest Glen Section, Silver Springs, Maryland. This survey will verify that there is either no remaining residual radioactivity in the building and that the building decommissioned in compliance with the NRC and State of Maryland guidelines for the decontamination of facilities prior to release for unrestricted use.

(a) The WRAMC Health Physics Office will be responsible for decommissioning this facility. WRAMC Health Physics Office staff along with five WRAIR soldiers under the direction of the WRAMC Health Physics Office Operations Branch under CPT Arthur Morton will plan, conduct and analyze the survey results. The final approval authority for this decommissioning plan is the WRAMC RPO, COL William B. Johnson and the WRAMC Radiation Control Committee.

(b) The resources used in this project will include portable survey meters and laboratory facilities located at the WRAMC Health Physics Office, building 41, WRAMC.

(2) Decision Statement. To determine if all the survey units satisfy the U.S. Army and NRC release criteria for unrestricted use.

(3) Inputs to the Decision. A historical site assessment researched any radionuclides used, stored or disposed of in building 506. Based on the radionuclides used, stored or disposed of in each survey unit, and the room final surveys, survey units were designated and classified. Representative background measurements were obtained from the maintenance lounge, which shares a common wall with building 506 and was built with similar construction materials as the laboratories.

(4) Boundaries of the Study. The boundaries of the study are the interior of building 506 which includes room numbers A through H, storage, restroom or break areas inside the building. See a copy of the floor plan in Appendix C. There is no radioactive material in the building, and all radioactive use equipment has been cleared of any residual contamination and removed from building 506. Room contamination finals have been performed prior to the decommissioning survey.

(5) Decision Rule. If the mean concentration in the survey unit is less than the investigation level, then the survey unit will be in compliance with the release criteria. If the difference between the mean concentration in the survey unit and

the mean concentration in the reference area is less than the investigation level, then the survey unit is in compliance with the release criteria. If the average level of residual radioactivity within the survey unit exceeds the regulatory limit, or if small areas within the survey unit with elevated residual activity exceed the regulatory limit then the survey unit will require further remediation before unrestricted release.

(6) Decision Errors. The lower bound for the sample distribution is background determined from a laboratory in the northern end of the building (room B) and the upper bound on the sample distribution is three times the $DCGL_W$.

(7) Survey Design. The design goal will be to minimize the number of false negative measurements, or to release a survey unit containing residual radioactivity above three times the DCGL (Type I error). The design goal will also attempt to minimize the number of false positive measurements (Type II error) which will add cost and time to the decommissioning effort. The null hypothesis for this survey is that the survey unit exceeds the release criteria. The design goal for the relative shift (Δ/σ) value will be to achieve a relative shift of two for a Class 2 survey unit and for a relative shift of 3 for a Class 3 survey unit. The values for a Type I decision error (α) and a Type II decision error (β) are equal to 0.05.

b. Implementation Phase. The data collected will be reviewed daily to ensure that the daily quality objectives are met and that the data is consistent over the course of the survey. Both random and systematic sampling designs will be incorporated into this survey based on survey unit classification. The schedule for decommissioning this location is approximately one month beginning 12 April 1999. The decommissioning effort for this location will not consider using passive controls for releasing a survey unit.

c. Assessment Phase. The assessment phase includes verification and validation of the survey data and an assessment of the quality of the data to ensure the data meet the objectives of the survey.

(1) Data Verification. The performance of tasks by personnel will be conducted according to the SOP, and will be

assessed using inspections, and surveillance. The performance of the equipment will be monitored daily using control charts.

(2) Data Validation. Data qualifier codes used in this survey report are:

(a) < MDC. The concentration of the radionuclide of interest was below the minimum detectable concentration (MDC) which is defined in this survey as 3 + 4.65 times the square root of the mean background counts.

(b) J. The associated value was modified, adjusted or an estimated quantity. This qualifier may be used to identify results based on surrogate measurements or gross activity measurements. The implication is that the estimate may be imprecise or inaccurate, and may be inappropriate for statistical evaluations. The potential uncertainty associated with this qualifier will be included with the results.

(c) R. The associated value was determined to be an outlier and is excluded in statistical evaluations.

(d) F. In a Class 2 survey unit, the value exceeds the predetermined investigation level and is flagged for further study as shown in the following table:

Survey Unit Classification	Flag Direct Measurement or Sample Result	Flag Scanning Measurement
Class 2	> $DCGL_W$	> $DCGL_W$ or > MDC
Class 3	> 0.1 times $DCGL_W$	> $DCGL_W$ or > MDC

(3) Preliminary Data Review.

(a) The survey data from the field and laboratory measurements will be converted to DCGL units. Basic statistical quantities that will be calculated for each data set are the mean, standard deviation, and median values. A quantile plot and background measurements will be prepared for each class 2 survey unit, and any class 3 survey unit that fails the sign test for direct or sample results.

(b) The one sample statistical test (Sign test) will be used since the contaminants, technetium, iodine and chromium are either not present in the background or could be considered insignificant and radionuclide specific measurements will be made. If any measurement in the survey unit exceeds the $DCGL_W$,

the Sign test will be used to determine if the survey unit meets release criteria. Since all survey units are designated as Class 2 or Class 3 areas, no area of elevated activity is expected.

(c) The final status survey parameters for the survey units are shown in the following table:

Survey Unit	Type	DQO		Relative Shift	$DCGL_w$			Test
		α	β	Δ/σ	H-3	C-14	S-35	
Interior, Prior Rad use Removable	Class 2	0.05	0.05	2	1000 dpm per 100 cm^2	1000 dpm per 100 cm^2	1000 dpm per 100 cm^2	Sign
Interior, Non-Rad use Removable	Class 3	0.05	0.05	3	1000 dpm per 100 cm^2	1000 dpm per 100 cm^2	1000 dpm per 100 cm^2	Sign
Interior, Prior Rad use Meter	Class 2	0.05	0.05	2	5000 dpm per 100 cm^2	5000 dpm per 100 cm^2	5000 dpm per 100 cm^2	Sign
Interior, Non-Rad use Meter	Class 3	0.05	0.05	3	5000 dpm per 125 cm^2	5000 dpm per 125 cm^2	5000 dpm per 125 cm^2	Sign

(d) The minimum number of sample points required for Class 3 survey units using the Sign test when the contaminant is not in the background is 14 from Table 5.5, MARSSIM manual NUREG-1575. For the Class 2 survey units, the survey locations are based on a symmetrical triangular grid with spacing between measurements of 5 feet based on the following formula where the area of room C is 400 square feet and the value of N is 15 based on Table 5.5, MARRAIM manual NUREG-1575:

$$L = \sqrt{\frac{A}{0.866 * n_{EA}}}$$

(e) The starting location for each survey unit will be determined using a random number generator in a spreadsheet program with a grid spacing of 10 points per every 3 foot grid square. For a Class 2 survey unit, a symmetrical triangular grid pattern beginning from a randomly selected starting point will be superimposed on the rectangular reference grid. For Class 3 survey units, 14 data points are selected using a random number generator will superimposed on the rectangular reference grid.

Area Classification	Structures	
	Surface Scans	Surface Activity Measurements
Class 2	10 to 100% (10 to 50% of upper walls and ceilings) Systematic and Judgmental	Number of data points from statistical tests
Class 3	Judgmental	Number of data points from statistical tests

(f) The level of scanning effort will be proportional to the potential for finding areas of elevated activity in the survey unit. A larger portion of the survey unit will be scanned if units have residual activity close to the release criterion. Areas that have the highest potential for contamination such as doors, corners, sinks and drains will be performed in all locations. Scanning techniques are not tied to the distance or area between measurement locations, but are rather dependent on the professional judgment of the surveyor.

d. A list of definitions and abbreviations is included in Appendix B.

e. Building diagrams, survey measurements, and resurvey measurements are provided in Appendix C.

f. A list of survey instruments and laboratory counters, calibration records, the minimum detectable activity for each instrument and the quality control charts used for this survey are provided in Appendix D.

4. HISTORICAL REVIEW.

a. Radioactive material was permitted to be used in room C, building 506 was used by the Walter Reed Institute of Research (WRAIR), Division of Communicable Diseases and Immunology, WRAMC Radioactive Material Authorization 649, from June 1990 to June 1993, and the Respiratory Research Group, WRAMC Radioactive Material Authorization 650, from July 1995 to present under NRC License 08-10738-02, managed by the WRAMC Health Physics Office. No documented use of radioactive materials under either authorization was found from the records review of both authorizations. Authorization 649 was permitted to use up to 2 millicuries of P-32, 1 mCi of tritium, 1 mCi of Sulfur-35 and 1 mCi of Carbon-14. Authorization 650 submitted a request to store and use radioactive material in building 506, but a records search indicated that they never received or used any material at this location. Authorization 650 requested to use room C,

building 506 for unsealed radioactive material use, but the authorization was on administrative hold the entire time, and never received or used unsealed radioactive materials. A liquid scintillation counter with a 10 microcurie Ra-226 sealed source was stored in building 506 and leak checked semi-annually with no unusual incidents recorded. Based on the short half-lives of the radioactive materials on authorization 649, and no documented use of radioactive materials in this building going back to at least June 1990, there should not be any reason to suspect any unsealed radioactive materials or areas of contamination would remain in building 506.

b. There was not a radioactive wash sink in building 506.

c. All records for room finals and equipment finals for the affected rooms are maintained in the Health Physics Office files.

d. Preliminary surveys were conducted in the building to reinforce the classification of all rooms as class III survey units with the exception of the main laboratory, room C, which for this survey is classified as a class II survey unit. No measurements above background levels were found on the building pre-survey.

5. RADIATION SURVEY INSTRUMENTATION.

a. Based on the results of the historical review, it was determined that this building would be surveyed for potential beta and gamma emitting radionuclides. The historical review found no unsealed alpha sources were ever used at this location. Since there was no record of any unsealed alpha sources, and the sealed radium source was leak tested every 6-months and removed from the liquid scintillation counter intact, this survey will not include screening for alpha contamination.

b. All beta-gamma portable survey instruments were checked for proper operation prior to use each day. Operational checks for field instrumentation as outlined in NUREG/CR-5849 were used as the standard for this decommissioning process. A series of 10 repetitive measurements of background and the check sources in 1 minute scaler mode are performed, the mean and standard deviation are determined with an acceptable response range of $+/- 2\sigma$.

c. Portable meters and laboratory counters were function checked and tested against NIST traceable check sources each day

prior to use. The following table lists the check sources used during this decommissioning process:

Manufacturer	Isotope	Activity	Date	Serial Number
Dupont	Cd-109	1.16 μCi	2 March 1993	
Packard	I-129	0.05 μCi	September 1997	471
Dupont	Cs-137	0.112 μCi	1 November 1993	
Packard	Co-57	210,900 dpm	13 October 1997	7,018,565
Packard	H-3	267,800 dpm	12 September 1995	
Packard	C-14	113,900 dpm	12 September 1995	
Packard	Cs-137	0.25 μCi	1 February 1997	

d. Blank smear samples were run through both the automated swipe counters. Random check sources were run through the automated swipe counters, using I-129 and Cs-137 check sources for the auto-gamma and H-3 and C-14 daily calibration standards and quench standards for the liquid scintillation counter (LSC).

6. RADIATION SURVEY TECHNIQUES.

a. The survey grid system used was an alphanumeric designator system using cardinal coordinates. North was taken as the side of the building most closely aligned with magnetic north. The coordinate system and approximately magnetic north are indicated on the building and room diagrams.

b. The floor and the walls were grided in 1 yard squares. If a grid square had elevated readings, the area was promptly decontaminated. Subsequent measurements of potentially contaminated areas were made by further subdividing the grid square into 9 smaller squares.

c. The entire floor, walls, counter tops, drawers, and any remaining equipment in room C was surveyed. Judgmental samples in all Class 2 areas were taken in locations chosen by the surveyors where they believed contamination could spread, or could have collected over time. These include cracks in walls or floors, holes in walls, drains, vents, lighting fixtures, etc. The ceilings were classified as unaffected areas and were not surveyed.

d. If an elevated meter reading was found that was at least 3 times background, the area was immediately decontaminated and resurveyed. If the auto-gamma or LSC indicated that an area had potential contamination measurements of more than 50 dpm above

background, the area was decontaminated and resurveyed. An EG&G portable multi-channel analyzer is available to determine the isotopic contamination present if required.

e. The results of the meter surveys, background measurements and check source measurements were recorded on the survey forms, signed and dated by the surveyor.

f. The LSC samples were counted for 5 minutes each. All results were recorded in 3 channels based on contiguous energy regions; H-3 region 0-15 keV, C-14 region 15-150 keV, and a higher energy beta region > 150 keV. The LSC automatically calculates the dpm for H-3 and C-14 based on the daily calibration sources run through each of the LSCs. Each line item in the LSC printout includes the survey location, the dpm for H-3 channel, the dpm for the C-14 channel, and the cpm for the highest energy channel and a color quench indicator. The dpm calculations for C-14 and H-3 are automatically color quenched corrected. The dpm calculation for all other beta emitters will then be determined based on the efficiency of the particular radionuclide as determined by the beta curve.

g. The auto-gamma samples were counted for 5 minutes each in the Cobra autogamma. If a sample indicates gamma contamination, the isotope will be determined using the Packard gamma spectroscopy software and the sample rerun through the isotope specific protocol to determine the activity of the sample.

h. As a minimum, the mean, standard deviation, median, minimum, and maximum measurement for each room excluding the background and check source measurements are shown in Appendix C.

7. INSTRUMENT SURVEY RESULTS.

a. Beta-Gamma Meter Results. A fixed meter reading was obtained using a Ludlum Data Logger with a G-M probe in the digital scaler mode set at 1-minute per sample. Meter readings were made in each grid square at a distance of less than 5-mm from the surface. All results by survey location are included in Appendix C. Some rooms had elevated background activity due to unremovable naturally occurring radioactive materials in the tile, ceramics, brick or other construction materials. For any room that failed the sign test, the data was evaluated using a quantile plot and a linear least squares fit to the data. If all the results showed slightly elevated activity, fit the expected normal distribution, the swipe results were negative, and the

elevated results could be attributed to construction materials then the survey unit was considered to meet the release criteria.

b. Gamma Meter Results. A fixed meter reading was obtained using the Ludlum Data Logger with a FIDDLER probe in the digital scaler mode set at 1-minute per sample. Meter readings were made in each floor grid square at a distance of about 1-m above the floor. All results by survey location are included in Appendix C. Some rooms had elevated background activity due to unremovable naturally occurring radioactive materials in the tile, ceramics, brick or other construction materials. For any room that failed the sign test, the data was evaluated using a quantile plot and a linear least squares fit to the data. If all the results showed slightly elevated activity, fit the expected normal distribution, the swipe results were negative, and the elevated results could be attributed to construction materials then the survey unit was considered to meet the release criteria.

c. LSC Results. Wipe samples were collected for each grid location by swiping approximately 100-cm^2. Blank samples were used to screen for cross contamination, and tritium, and carbon-14 spikes were used as quality control measures. All results by survey location are included in Appendix C. The quality control documentation is included in Appendix D. All of the laboratory results were below the release criteria.

d. Auto-Gamma Results. Wipe samples were collected for each grid location by swiping approximately 100-cm^2. Blank samples were used to screen for cross contamination, and iodine-129, and cesium-137 spikes were used as quality control measures. All results by survey location are included in Appendix C. The quality control documentation is included in Appendix D. All of the laboratory results were below the release criteria.

8. CONCLUSION. A review of all the survey results indicate that there are no radiological health hazards remaining Building 506, Forest Glen Section, Silver Springs, Maryland.

MCHL-HP
SUBJECT: Decommissioning of Building 506, Forest Glen Section, Silver Springs, Maryland

9. RECOMMENDATION. Recommend that Building 506 be released for unrestricted use.

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APPROVED:

WILLIAM B. JOHNSON
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Chief, Health Physics Office

APPENDIX A
REFERENCES

1. AR 385-11, 1 May 1980, Ionizing Radiation Protection (Licensing, Control, Transportation, Disposal, and Radiation Safety).

2. NUREG-1500, Working Draft Regulatory Guide on Release Criteria for Decommissioning: NRC Staff's Draft for Comment, August 1994.

3. NUREG-1501, Background as a Residual Radioactivity Criterion for Decommissioning, Draft Report for Comment, August 1994.

4. NUREG-1505, A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys.

5. NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, December 1997.

6. NUREG-1575, Multiagency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997.

7. NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination, Draft Report for Comment, June 1992.

8. NRC Administrative Letter 96-05: Compliance with the Rule "Timeliness in Decommissioning of Material Facilities," (59 FR 36026-36040, 15 July 1996), 5 November 1996.

9. Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation.

10. Reference letter, MCHL-HP, 12 December 1997, to the Nuclear Regulatory Commission, Region I, Division of Nuclear Material Safety, 475 Alendale Road, King of Prussia, Pennsylvania 19406-1415, Subject: Timeliness Rule Notification for Decommissioning of Buildings 508, 511, 40, 500, 506 and 512.

APPENDIX B
ABBREVIATIONS AND DEFINITIONS

SECTION I

ALARA
as low as reasonably achievable

ALI
annual limit of intake

AR
Army Regulation

Bkd
background

Cal
calibration

CEDE
committed effective dose equivalent

CFR
Code of Federal Regulations

CG
Commanding General

cm
centimeter

cm^2
square centimeter

CPM
counts per minute

DA
Department of the Army

$DCGL_{EMC}$
Derived Concentration Guideline Level - Elevated Measurement Comparison

$DCGL_W$
Derived Concentration Guideline Level - Wide Area

dpm
disintegrations per minute

eff
efficiency

eV
electron volt

FY
fiscal year

Gy
gray

h
hour

IAW
in accordance with

m
meter

µCi
microcurie

µm
micrometer

µR/hr
microroentgen per hour

mCi
millicurie

mg
milligram

mm
millimeter

mrad
millirad

mSv
millisievert

MDA
minimum detectable activity

NIST
National Institute of Standards and Technology

NRC
U.S. Nuclear Regulatory Commission

NUREG
Nuclear Regulatory Guide

QA
quality assurance

RAM
radioactive material

RCC
radiation control committee

RPO
radiation protection officer

sn
serial number

SOP
standing operating procedure

Sv
sievert

TEDE
total effective dose equivalent

USACHPPM
U.S. Army Center for Health Promotion and Preventive Medicine

Section II Terms

ALARA
Acronym for "as low as is reasonably achievable" means making every reasonable effort to maintain exposures to radiation as far below applicable dose limits as is practical consistent with the purpose for which the activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations and in relation to utilization of nuclear energy and licensed materials in the public interest.

Alpha (α)
The specified maximum probability of a Type I error. In other words, the maximum probability of rejecting the null hypothesis when it is true. Alpha is also referred to as the size of the test. Alpha reflects the amount of evidence the decision maker would like to see before abandoning the null hypothesis.

Annual limit of intake (ALI)
The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year that would result in a committed effective dose equivalent of 5rems (0.05Sv) or a committed dose equivalent of 50rems (0.5Sv) to any organ or tissue.

Army regulation
A directive that sets forth missions, responsibilities, and policies, and establishes procedures to ensure uniform compliance with those policies.

Background Radiation
Radiation from cosmic sources, naturally occurring radioactive material, radon, and global fallout as it exists in the environment from the testing of nuclear explosive devices or from nuclear accidents. Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the Federal or State agency.

Becquerel (Bq)
The SI unit of radioactivity equivalent to one nuclear transformation per second.

Beta (β)
The probability of a Type II error, the probability of accepting the null hypothesis when it is false. The complement of beta ($1-\beta$) is referred to as the power of the test.

Beta particle
An electron emitted from the nucleus during radioactive transformation.

Byproduct material
Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

Chain of Custody
An unbroken trail of accountability that ensures the physical security of samples, data and records.

Class 1 Area
A type of final status survey that applies to areas with the highest potential for contamination, and meet the following criteria: (1) impacted; (2) potential for delivering a dose above the release criterion; (3) potential for small areas of elevated activity; and (4) insufficient evidence to support reclassification as Class 2 or Class 3.

Class 2 Area
A type of final status survey that applies to areas that meet the following criteria: (1) impacted; (2) low potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity.

Class 3 Area
A type of final status survey that applies to areas that meet the following criteria: (1) impacted; (2) little or no potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity.

Committed dose equivalent
The dose equivalent to organs or tissue of reference that will be received from an intake of radioactive material by an individual during the 50 year period following the intake.

Committed effective dose equivalent
The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.

Commodity, radioactive
See Radioactive commodity

Curie
A unit of radioactivity equal to 37 billion becquerels.

Data Quality Assessment (DQA)
The scientific and statistical evaluation of data to determine if the data are of the right type, quality, and quantity to support their intended use.

Data Quality Objectives (DQO)
Qualitative and quantitative statements derived from the DQO process that clarify study technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision error that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

$DCGL_W$
Derived Concentration Guideline Level. Derived assuming the residual activity is uniformly distributed over a wide area, i.e., the entire survey unit.

$DCGL_{EMC}$
Derived Concentration Guideline Level - Elevated Measurement Comparison. Derived assuming the residual activity is concentrated in a small percentage of a survey unit. The $DCGL_{EMC}$ can never be less than the $DCGL_W$, but may be significantly greater.

Decommission
To remove (as a facility) safely from service and reduce residual radioactivity to a level that permits release of the property for unrestricted use and termination of the Nuclear Regulatory Commission license, Army reactor permit, or Army radiation authorization.

Decontamination
The removal of radiological contaminants from, or their neutralization on a person, object or area to within levels established by governing regulatory agencies.

Deep-dose equivalent
Applies to external whole-body exposure and is the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm2).

Delta (D)
The width of the gray region.

Dose equivalent
The product of absorbed dose in tissue, quality factor and all other necessary modifying factors at the location of interest in tissue. The units of dose equivalent are the rem and sievert (Sv).

Effective dose equivalent
The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

Electron volt (eV)
A unit of energy equal to 1.6×10^{-19} joule.

Eye dose equivalent
Applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm^2).

Final Status Survey
Measurements and sampling to describe the radiological conditions of a site, following completion of decontamination activities (if any) in preparation for release.

Giga- (G)
An SI unit prefix indicating a factor of one billion (10^9).

Gamma radiation
Penetrating high-energy, short wavelength electromagnetic radiation emitted during radioactive transformation. Gamma rays are very penetrating and require dense materials for shielding.

Gray (Gy)
The SI unit of absorbed dose. One gray is equal to an absorbed dose 1 joule/kilogram (100 rads).

Gray region
A range of values of the parameter of interest for a survey unit where the consequences of making a decision error are relatively minor. The upper bound of the gray region in MARSSIM is set equal to the $DCGL_W$, and the lower bound of the gray region is a site-specific variable.

Impacted area
Areas with a possibility of containing residual radioactivity in excess of natural background or fallout levels.

Indistinguishable from background
The detectable concentration distribution of a radionuclide is not statistically different from the background concentration distribution of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

Installation
A grouping of facilities located in the same vicinity, which support particular functions. Installations may be elements of a base. Land and improvements permanently affixed thereto which are under the control of the Department of the Army and used by Army organizations. Where installations are located contiguously, the combined property is designated as one installation and the separate functions are designated as activities of that installation. In addition to those used primarily by troops, the term "installation" applies to real properties such as depots, arsenals, ammunition plants (both contractor and Government operated), hospitals, terminals, and other special mission installations.

Investigation level
A derived media-specific, radionuclide specific concentration or activity level of radioactivity that: 1) is based on the release criterion; 2) triggers a response, such as further investigation or cleanup, if exceeded.

Ionizing radiation
Charged subatomic particles and ionized atoms with kinetic energies greater than 12.4 eV, electromagnetic radiation with

photon energies greater than 12.4 eV, and all free neutrons and other uncharged subatomic particles (except neutrinos and antineutrinos because they produce negligible ionization).

Kilo- (k)
An SI unit prefix indicating a factor of 1000.

Lower limit of detection (L_D)
The smallest amount of radiation or radioactivity that statistically yields a net result above the background. The critical detection level, L_C, is the lower bound of the 95% detection interval defined for L_D and is the level at which there is a 5% chance of calling a background value "greater than background." This value should be used when actually counting samples or making direct radiation measurements. Any response above this level should be considered as above background. This will ensure 95% detection capability for L_D. A 95% confidence interval should be calculated for all responses greater than L_C.

Micro- (m)
An SI unit prefix indicating a factor of one one-millionth (10^{-6}).

Milli- (m)
An SI unit prefix indicating a factor of one one-thousandth (0.001).

Minimum Detectable Concentration (MDC)
The minimum detectable concentration is the a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. When stating the detection capability of an instrument, this value should be used. The MDC is the detection limit, L_D, multiplied by an appropriate conversion factor to give units of activity.

Non-impacted area
Areas where there is no reasonable possibility (extremely low probability) of residual contamination. Non-impacted areas are typically located off-site and may be used as background reference areas.

Nonparametric test
A test based on relatively few assumptions about the exact form of the underlying probability distributions of the measurements. As a consequence, nonparametric tests are generally valid for a

fairly broad class of distributions. The Wilcoxon Rank Sum test and the Sign test are examples of nonparametric tests.

Outlier
Measurements that are unusually large or small relative to the rest and therefore are suspect of misrepresenting the population from which they were collected.

Qualified expert
A person who by virtue of training and experience can provide competent authoritative guidance about certain aspects of radiation protection. Being a qualified expert in one aspect of radiation protection does not necessarily imply that a person is a qualified expert in another aspect. Forward requests for determination of whether a certain individual is a qualified expert through command channels to the MACOM RPSO as necessary. Forward these requests to HQDA (DACS-SF), Washington, DC 203100200, for further evaluation as necessary.

Quality factor
The modifying factor [listed in tables 1004(b).1 and 1004(b).2 of 10 CFR20.1004] that is used to derive dose equivalent from absorbed dose.

Rad
A unit of absorbed dose. One rad is equal to an absorbed dose of 0.01 joule/kilogram (0.01 gray).

Radiation
For the purposes of this regulation, unless otherwise specified, radiation includes both ionizing and non-ionizing radiation.

Radiation area
An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005rem (0.05mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Radiation protection
For the purposes of this regulation, a scientific discipline whose objective is the protection of people and the environment from unnecessary exposure to radiation. Radiation protection is concerned with understanding, evaluating, and controlling the risks from radiation exposure relative to the benefits derived. Also called "health physics" and "radiation safety."

Radiation Control Committee
An advisory committee for the commander to assess the adequacy of the command's radiation protection program.

Radiation Protection Officer
The person that the commander designates, in writing, as the executive agent for the command's radiation protection program. Also called "radiation safety officer" or "health physics officer."

Radiation protection program
A program to implement the objective of radiation protection.

a. The Army's radiation protection program includes all aspects of measurement and evaluation of radiation and radioactive material as they pertain to protection of personnel and the environment, and of the Army's radiation dosimetry, radiation bioassay, radioactive waste disposal, radiation protection training, and radiation instrument TMDE and calibration programs.

b. A command's radiation protection program includes all aspects of measurement and evaluation of radiation and radioactive material within the command as they pertain to protection of personnel and the environment.

Radioactive commodity
An item of Government property made up in whole or in part of radioactive material. A national stock number (NSN) or part number is assigned to commodities containing radioactive material greater than 0.01 microcurie.

Radioactive waste
Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act, as amended, or is of sufficient quantity to require an Army radiation authorization, and is of negligible economic value considering the cost of recovery.

Radioactive waste, low-level
Material the NRC classifies as low-level radioactive waste (see 10 CFR 62.2); waste not classified as high-level radioactive waste (spent nuclear fuel), as transuranic waste, or as uranium or thorium tailings and waste; material acceptable for burial in a land disposal facility (10CFR 61).

Relative shift (Δ/σ)
The standard deviation of the measurements, is the relative shift expressed in multiples of the standard deviations.

Rem
A unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 sievert).

Shallow dose equivalent
Applies to the external exposure of the skin or an extremity and is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area 1 square centimeter.

Sievert (Sv)
The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rems).

Sign test
A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide of interest is not present in background and the distribution of data is not symmetric.

Standing Operating Procedure (SOP)
A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and that is officially approved as the method for performing certain routine or repetitive tasks.

Survey
A systematic evaluation and documentation of radiological measurements with a correctly calibrated instrument or instruments that meet the sensitivity required by the objective of the evaluation.

Total effective dose equivalent
The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Unrestricted release

Release of a site from regulatory control without requirements for future radiological restrictions.

Weighting factor
For an organ or tissue, the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly.

Wilcoxon Sum Rank test
A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide of interest is present in background and the distribution of data is not symmetric.

APPENDIX C

BUILDING DIAGRAMS, SURVEY MEASUREMENTS, RESURVEY MEASUREMENTS

Historical Review of Affected Areas					
Room	Auth.	Final	Isotopes	mCi	Comments
C	649	6/93	P-32	2	No recorded use
	650	6/99	H-3	2	No recorded use
	650	6/99	I-125	1	No recorded use
There should be no long lived radionuclides in this room at the time of the survey. There were no records of spills or incidents in this room.					

Room	**Survey Unit**	**Sign Test**				**Notes**
		Lab NaI	Lab LSC	GM Meter	NaI Meter	
A, Mens, Womens, Hallway C	III	Pass	Pass	Pass	Pass	
B	III	Pass	Pass	Pass	Pass	
C	II	Pass	Pass	Pass	Pass	
E1, E2, Hallway A, Hallway B	III	Pass	Pass	Pass	Pass	
F, G, Hallway B	III	Pass	Pass	Pass	Pass	
H1, H2, D, Hallway B	III	Pass	Pass	Pass	Pass	
Storage Room	III	Pass	Pass	Pass	Pass	
Drawers in Room C	III	Pass	Pass	Pass	Pass	

MCHL-HP
SUBJECT: Decommissioning of Building 506, Forest Glen Section, Silver Springs, Maryland

APPENDIX D

SURVEY METERS, LABORATORY COUNTERS, QUALITY CONTROL DATA

1. The portable meters used in this survey include:

Manufacturer	Model	Serial Number	Calibrated	Calibration Due
Ludlum	Datalogger 2350	82942	23 Mar 99	19 Sep 99
Ludlum	Datalogger 2350	82953	23 Mar 99	19 Sep 99
Ludlum	Datalogger 2350	82941	25 Mar 99	21 Sep 99
Ludlum	Datalogger 2350	82960	25 Mar 99	21 Sep 99

2. The laboratory counters used in this survey include:

Manufacturer	Model	Serial Number	Calibrated	Calibration Due
Packard	2500TR	408523	Mar 99	Sep 99
Packard	2500TR	103407	Mar 99	Sep 99
Packard	5530	400577	Mar 99	Sep 99
Packard	Cobra	416334	Feb 99	Aug 99