West Virginia University
RADIATION SAFETY SERVICES

NMSB2

August 9, 2005

Betsy Ullrich
Sr. Health Physicist
US Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415
(610)-337-5040

SNM-1990
0700371

RE: Final Status Survey for Decommissioning for West Virginia University Institute of Technology Engineering Classroom Bldg Room 105

Dear Mrs. Ullrich:

West Virginia University Radiation Safety Department submits a copy of the documents that certifies Decommissioning of West Virginia University Institute of Technology Engineering Classroom Bldg Room 105. Please find enclosed a copy of this report. If you have any question regarding the report please give me a call at 304-293-1554 or e-mail me nrazmianfar@hsc.wvu.edu. In case you could not reach me , call Tim Osborne at 410-381-2600.

Sincerely yours,

Nasser Razmianfar
Director and Radiation Safety Officer

Cc: Charles Bayless, WVUIT President

Robert C. Byrd Health Sciences Center
West Virginia University
WVU Hospitals

G-139 Health Sciences North
PO Box 9006
Morgantown, WV 26506-9006

Phone: 304-293-3413
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From: "Nasser Razmianfar" <nrazmianfar@hsc.wvu.edu>
To: <JPD1@nrc.gov>
Date: 8/16/05 9:55AM
Subject: Re: Final Status survey

Dear Mr. Dwyer,

Please remove the Proprietary Marking from " Final Status Survey for Decommissioning" submitted to USNRC for West Virginia University Institute of Technology.
I appreciate your assistance regarding this matter.

SNM-1990
070 03071

Nasser Razmianfar, RSO
Director and Radiation Safety Officer
WVU. RCB HSC. WVU Hospitals
WVU Radiation Safety Department
P.O. Box 9006
Morgantown, WV 26506-9006
Phone: 304-293-1554
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nrazmianfar@hsc.wvu.edu

>>> "James Dwyer" <JPD1@nrc.gov> 8/15/2005 4:48:19 PM >>>
Mr. Razmianfar,

Your August 9, 2005 letter to Betsy Ullrich of my staff encloses a "Final Status Survey for Decommissioning" prepared by Ecology Services, Inc. The Final Status Survey indicates the report contains proprietary information which shall be held in Strictest Confidence. To withhold something as proprietary, we require that you follow the instructions in 10 CFR 2.390. Please provide the required affidavit, along with the basis for your request, or advise that we can remove the proprietary marking from the report.

Jim Dwyer, Chief
Commercial and R&D Branch
Division of Nuclear Materials Safety

CC: <EXU@nrc.gov>, <MAP1.kp1_po.KP_DO@nrc.gov>

13751Z

Mail Envelope Properties (4301F029.0B0 : 19 : 12464)

Subject:	Re: Final Status survey
Creation Date:	8/16/05 9:55AM
From:	"Nasser Razmianfar" <nrazmianfar@hsc.wvu.edu>
Created By:	nrazmianfar@hsc.wvu.edu

Recipients

nrc.gov
- kp1_po.KP_DO
  - EXU CC (Elizabeth Ullrich)
  - JPD1 (James Dwyer)
  - MAP1 CC (Michael Perkins)

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Security:	Standard

ECOLOGY
SERVICES, INC.

West Virginia University

SNM-1990
02003071

FINAL STATUS SURVEY FOR DECOMMISSIONING

for

West Virginia University
Institute of Technology
Engineering Classroom Bldg
Room 105

Prepared by:

ECOLOGY SERVICES, INC.

10220 OLD COLUMBIA ROAD
COLUMBIA, MD 21046

137512

ECOLOGY SERVICES, INC.

FINAL STATUS SURVEY FOR DECOMMISSIONING

for

West Virginia University Institute of Technology Engineering Classroom Bldg Room 105

Prepared by:

ECOLOGY SERVICES, INC.

10220 OLD COLUMBIA ROAD
COLUMBIA, MD 21046

Rev	Originator	Reviewer	Quality Assurance
1	T. Osborne, CHP	B. Daniels	R. Rilee
Signature		BRETT B. DANIELS	RM for R. Rilee
Date	7-14-05	7/14/05	7-14-05

Final Status Survey (FSS)
for WVU Institute of Technology

405 Fayette Pike
Montgomery, WV 25136

I. INTRODUCTION

A. Site Information:

WVU Institute of Technology is authorized by the U.S. Nuclear Regulatory Commission with Radioactive Materials License number SNM-1990 (expiration May 31, 1996) to possess Plutonium sealed neutron sources and natural Uranium canned in cylindrical containers at their facility in Montgomery, WV. The facility is located at 405 Fayette Pike Montgomery, WV 25136. The area of concern for a final status survey is room 105 in the Engineering Classroom building, within the control of Radiation Safety. Ecology Services, Inc. was contracted to perform a final status survey in support of the decommissioning of the area of concern. This area is scheduled for non-radioactive use by another University department. The area of concern was surveyed on June 7, 2005 in order to demonstrate that radiological conditions satisfy regulatory agency requirements for release.

B. Site History

West Virginia is authorized by the U.S. Nuclear Regulatory Commission with Radioactive Materials License number 47-23035-01 (expiration January 31-2012) to use a wide range of radionuclides. Dr. Barry Illman, representing WVU Institute of Technology, did not anticipate any areas that would be expected to have residual contamination. Radioactive waste, packaged for transport, was shipped on April 17, 2003 prior to the survey activities. The area of concern was surveyed on June 7, 2005 to document the current radiological conditions for free release.

C. Release Criterion

1. The release criterion, against which the survey findings will be applied, will be those specified by the NRC. The site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem per year, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).
2. For removable and surficial contamination, this release criteria will be translated into Derived Concentration Guideline Levels (DCGLs) for the identified potential contaminants using the DandD software program (version 2.1.0) and the Building Occupancy Scenario (using default parameters).

D. Study Boundaries

The final status survey is restricted to the interior of the facility.

E. Decision Rule

1. The parameters of interest in determining whether the survey results satisfy the release criteria will be the DCGLs for surficial contamination and exposure rates at 1 meter for volumetric contaminants.

2. Survey Units will be evaluated using four methods, each being used to determine fixed or removable contamination levels which will be evaluated against the DCGLs.

TABLE 1 - EVALUATION METHODS	
EVALUATION METHOD	PARAMETER IDENTIFIED
Scanning Surveys.	Fixed and Removable Contamination
Static Measurements at selected points.	Fixed and Removable Contamination Exposure Rates
Wipe sample measurements.	Removable Contamination
Additional wipe sample tests and static measurements (judgmental)	Removable Contamination –wipe samples Fixed and Removable Contamination – Static Measurements

II. SURVEY PLANNING AND DESIGN – See Attachment 1

III. CONDUCT OF THE SURVEYS

A. Area Classifications. Survey units were established as Class 1 areas, based upon the potential for contamination. Since the Area of Concern consisted of a single room, there was one Class 1 area designated.

B. Calibration and background determinations were done as stated in the planning documents. (See Attachment 1)

C. Scan Surveys. The Class 1 area was scanned as follows: First using a ZnS(Ag) scintillation probe for α emitting radionuclides, the second a thin NaI(Tl) low energy gamma detector for γ emitting radionuclides. Coverage fractions by area class are shown in Table 2. Results of the Scan Surveys are shown in Attachment 3.

TABLE 2 - SCANNING COVERAGE			
Class	**Survey Type**	**Detector**	**Scanning Coverage Fraction**
1	α Scan	Ludlum 43-90	100 percent
1	γ Scan	Ludlum 44-17	100 percent at 5-6 " distance
2	α Scan	Eberline 43.90	50 percent
2	γ Scan	Ludlum 44-17	50 percent at 5-6 " distance

D. Measurement Locations.

1. A scale drawing of the survey unit was prepared, along with an overlying planar reference coordinate system. (See Attachment 2) The number of survey locations, n, was determined during the survey planning and design. (See Attachment 1) Due to the size of the survey unit, a triangular grid pattern was elected. The number of survey locations was used to determine the spacing, L, of a systematic pattern by:

$$L = \sqrt{\frac{A}{0.866n}}$$

Where A is the area of the survey unit. Here, the available floor surface was 47 m^2 and n was found to be 9, therefore L=2.81m. A random coordinate location was identified as a pattern starting location. From this location, a row of points parallel to the X axis was constructed at intervals of L. A second row of points was constructed parallel to the first row, at a distance of 0.866 x L from the first row. This process was repeated until the affected area was covered. (See Attachment 2)

2. The actual MDC_{SCAN} for the instruments available at the site were determined. Since the actual MDC_{SCAN} was less than or equal to the required MDC_{SCAN}, no additional sampling points were necessary for assessment of small areas of elevated activity.

TABLE 3 – STATIC SURVEY COVERAGE			
Class	**Survey Type**	**Detector**	**Scanning Coverage Fraction**
1	α Static	43-1	Grid Intervals
2	α Static	43-1	Judgmental
2	γ Static	44-17	Judgmental

3. Wipe Samples for removable contamination were taken at each data point determined in 1. above. Results of the wipe samples are shown in Attachment 3.

IV. EVALUATION OF SURVEY RESULTS

A. Scan Surveys. No areas of elevated activity were noted during any of the scan surveys.

B. Static Measurement Surveys.

1. Wipe Samples. All wipe sample results were shown to be less than the DCGLs, and were in fact, less than the L_D's (Attachment 3)

2. No areas of elevated activity were noted during any of the α or γ static measurement surveys. (See Attachment 3)

3. Judgmental surveys were conducted for α and γ emitters. No areas of elevated activity were noted.

4. The direct readings of exposure taken with the Ludlum γ instrument ranged from 8-10 μR/hr with a background in the same range. There were no detectable levels above the background.

C. Comparison with Standards

1. Surficial Contamination.

a. All wipe sample data was shown to be below the DCGLs.

b. All scan data was determined to be less than the DCGL for 25 mrem/year for the most restrictive radionuclide (^{238}U).

c. All static measurement data was shown to be below the DCGLs for 25 mrem/year for the most restrictive radionuclide (^{238}U).

d. The above shows that all data are ≤ the DCGL's.

2. Volumetric Contamination.

a. There was no evidence of volumetric contamination.

V. DETERMINATION OF COMPLIANCE WITH STATE AND/OR FEDERAL STANDARDS

A. Determination of compliance is conducted in two steps. The first is to review the measurement data to confirm that the survey units were properly classified. Since no Grids demonstrated contamination above the DCGL's, and volumetric constituents did not indicate to the contrary, the areas were properly classified.

B. The second step is to determine whether the measurement results demonstrate that the survey units meet the radiological criteria for unrestricted release. The above analysis indicates that all areas, and all survey results are below the DCGL's, or that measured radiation levels are below the required standards. Therefore the null hypothesis is rejected and the survey units are acceptable.

VI. CONCLUSION

The Engineering Classroom facility, Room 105, is acceptable for unrestricted release.

Timothy W. Osborne, CHP
Project Manager

Attachments:

1 – Final Status Survey Planning & Design
2 – Facility Maps
3 – Survey Measurement Data

Enclosure 1

FINAL STATUS SURVEY PLANNING AND DESIGN

A Problem Statement:

1. The WVU Institute of Technology (the "facility") has terminated activities with licensed materials and must be released for unrestricted use in accordance with the NRC's license termination rules.

2. A final status survey is planned to determine whether or not all the survey units identified satisfy the release criterion.

B Release Criterion

1. The release criterion, against which the survey findings will be applied, will be those specified by the NRC in their Radiological Criteria for License Termination. (10 CFR §20 Subpart E) Specifically:

   > The site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem per year, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

2. This release criteria will be translated into Derived Concentration Guideline Levels (DCGLs) for the identified potential contaminants using the DandD software program (version 2.1.0) and the Building Occupancy Scenario (using default parameters).

C Study Boundaries

The final status survey is restricted to the interior of room 105 of the Engineering Classroom Building on the WVU Institute of Technology campus in Montgomery, WV.

D Decision Rule

1. The parameter of interest in determining whether the survey results satisfy the release criteria will be the Derived Concentration Guideline Levels (DCGLs)

2. Survey Units will be evaluated using four methods, each being used to determine fixed or removable contamination levels which will be evaluated against the DCGLs.

TABLE 1 - EVALUATION METHODS

EVALUATION METHOD	PARAMETER IDENTIFIED
Scanning Surveys.	Fixed and Removable Contamination
Static Measurements at selected points.	Fixed and Removable Contamination Exposure Rates
Wipe sample measurements.	Removable Contamination
Additional wipe sample tests and static measurements (judgmental)	Removable Contamination

E Survey Design

Survey planning and procedures were in accordance with the NRC NUREG 1575 "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), Draft Regulatory Guide DG-4006, "Demonstrating Compliance with the Radiological Criteria for License Termination", U.S. NRC, August 1998., and NUREG - 1757, Consolidated NMSS Decommissioning Guidance, Decommissioning Process for Materials Licensees, Vol. 1&2, September, 2002.

This FSS is designed for a Group 2 facility. This is a facility that may have residual radiological contamination present on building surfaces. However, the licensee is able to demonstrate that his facility meets the provisions of 10 CFR 20.1402 ("Radiological Criteria for Unrestricted Use") by applying the screening approach to dose analysis. (NUREG 1757, Chapter 6) Additionally, the licensee possesses historical records of material receipt, use, and disposal, such that quantifying past radiological material possession and use may be developed with a high degree of confidence. Furthermore, these licensee has radiological survey records that characterize the residual radiological contamination levels present within the facility and at their site. That is, he is able to demonstrate residual radiological contamination levels without more sophisticated survey procedures (greater than those used for operational surveys) or dose modeling. The licensee does not need to use site-specific parameters or establish site-specific DCGLs in order to demonstrate acceptability for release of the site.

The licensee has verified that all of the following site conditions exist:

A Building Surface Contamination

- The contamination on building surfaces (e.g., walls, floors, ceilings) is surficial and non-volumetric (e.g., < 10 mm (0.4 in)).
- Contamination on surfaces is mostly fixed (not loose), with the fraction of loose contamination not to exceed 10 percent of the total surface activity.
- The screening criteria will not be applied to surfaces such as buried structures (e.g., drainage or sewer pipes) or mobile equipment within the building; such structures and buried surfaces will be treated on a case-by-case basis.

B ALARA (As Low As Reasonably Achievable) Considerations

In order to terminate a license, a licensee must demonstrate that the release criteria have been met and must demonstrate whether it is feasible to further reduce the levels of residual radioactivity to levels below those necessary to meet the release criteria (i.e. to levels that are "as low as reasonably achievable" (ALARA). However, explicit analyses do not have to be done for areas where no residual radioactivity distinguishable from background has been found. If residual radioactivity cannot be detected, it may be assumed that it has been reduced to levels that are ALARA [NRC Draft Reg Guide 4006, Sec 3.] The procedures for ALARA analyses are shown in Attachement 2.

Impacted Areas: Impacted areas were identified by using knowledge of past site operations together with site characterization surveys. In the Final Status Survey (FSS), radiation surveys do not need to be conducted in non-impacted areas.

- *Impacted areas* are areas that may have residual radioactivity from the licensed activities.
- *Non-impacted areas* are areas without residual radioactivity from licensed activities.

Area Classification: Impacted areas were classified into only one class, listed below, based on its levels of residual radioactivity.

- **Class 1 Areas** are impacted areas that, prior to remediation, are expected to have concentrations of residual radioactivity that exceed the DCGLw. (DCGLw is defined in Section 2.2 of MARSSIM);

Surveys conducted during operations or during characterization at the start of decommissioning are the basis for classifying areas. If the available information was not sufficient to designate an area as a particular class, the area was classified as Class 1.

Area Classifications for the facility will be as shown in Table 2 below:

TABLE 2 – Area Classifications	
Location	**Area Classification**
Engineering Classroom Bldg Room 105	Class 1
Hallways	Non-Impacted

Reference Grids

Grids will be established for the purpose of referencing locations of samples and measurements, relative to site features. A scale drawing of the survey unit will be prepared, along with an overlying planar reference coordinate system. Due to the size of the survey unit, a triangular grid pattern will be used. The number of survey locations will be used to determine the spacing, L, of a systematic pattern by:

$$L = \sqrt{\frac{A}{0.866n}}$$

Where A is the area of the survey unit. A random coordinate location will be identified as a pattern starting location. From this location, a row of points parallel to the X axis will be constructed at intervals of L. A second row of points will be constructed parallel to the first row, at a distance of 0.866 x L from the first row. This process was repeated until the affected area is covered.

Sample locations will be indicated on the area maps.

Selection of Reference (Background) Areas

Background reference areas are needed for the MARSSIM method if (a) the residual radioactivity contains a radionuclide that occurs in background, or (b) the sample measurements to be made are not radionuclide-specific.

Reference areas for wipe samples will not be selected since it is assumed that all removable radioactivity in the survey unit is caused by licensed operations and none is from background. Instrument background measurements for fixed contamination surveys and scans will be taken in other surrounding hallways of similar construction with no history of radioactive materials use.

Meter Scan Requirements

Scanning of surfaces to identify locations of residual surface and near surface activity will be performed according to the following schedule:

- Class 1 Area Surfaces – 100% of surface

Building interior surface scans will be conducted for alpha radiation as applicable. Instrumentation for scanning is listed in **Table 3**.

Table 3 - Instrumentation for Alpha Scanning				
Instrument	Detector	Efficiency		
		ε_i	ε_s	Total
Ludlum model 12	Ludlum 43-90	.40	.29	.116

The instruments having the lowest detection sensitivity will be used for the scans wherever physical surface conditions and measurement locations permit. Scanning speeds will be, at a maximum, one half (1/2) detector width per second. Audible features on the instrumentation will be used to identify locations having elevated count rates. If identified, these locations will be noted for further investigation.

Static measurements will be taken with the instrument indicated in **Table 10**. Measurements will be taken on floor surfaces using the scaler function of the instruments for a count time of 1 minute.

F Statistical Tests for Survey Data

1. The nonparametric statistical test used in this survey is designed to determine whether or not the level of residual activity uniformly distributed throughout each survey unit exceeds the DCGLs.

2. For the purpose of the statistical evaluation of data, the null hypothesis (H_0) will be adopted, i.e. the survey unit exceeds the release criterion. This requires significant evidence that the residual radioactivity in the survey unit is less than the release criterion to reject the null hypothesis (and pass the survey unit) In this case, a Type I decision error occurs when the null hypothesis is rejected when it is true, and is referred to as a false positive error; denoted by alpha (α). A Type II decision error occurs when the null hypothesis is accepted when it is false. This is referred to as a false negative error; denoted by beta (β).

TABLE 4 - DECISION ERRORS [MARSSIM APP D]

H_0: THE RESIDUAL ACTIVITY IN THE SURVEY UNIT EXCEEDS THE RELEASE CRITERION

		DECISION	
		Reject H_0 (Meets Release Criteria)	Accept H_0 (Exceeds Release Criterion)
TRUE CONDITION OF SURVEY UNIT	Meets Release Criterion	(No decision error)	Incorrectly Fail to Release Survey Unit (Type II)
	Exceeds Release Criterion	Incorrectly Release Survey Unit (Type I)	(No decision error)

3. Since the radionuclides of interest are present in background, the Wilcox Rank Sum Test will be used to evaluate data. The acceptable probabilities of Type I decision errors (α) and Type II decision errors (β) will be as follows:

TABLE 5 - ACCEPTABLE PROBABILITIES

Decision Error	Acceptable Probabilities
Type I error (α)	.05
Type II error (β)	.05

G Determination of the Number of Samples Required:

1. The following shows the calculations used to determine the number of samples required for each survey unit. [MARSSIM Sec 5.5.2.3]

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

Definition of Terms:

1) DCGL - Derived Concentration Guideline Level
2) LBGR - Lower Bound of the Grey Region
3) Δ (Shift) - (DCGL - LBGR)
4) σ_s - Standard Deviation
5) Δ/σ_s - relative shift
6) P_r – The probability that a random measurement from the survey unit exceeds a random measurement from the background reference area by less than the $DCGL_w$ when the survey unit median is equal to the LBGR above background.
7) $Z_{1-\alpha}$ & $Z_{1-\beta}$ – Decision Error Percentiles (Table 5.2, MARSSIM)
8) N - Number of data points for the Wilcox Rank Sum test

TABLE 6 - DETERMINATION OF REQUIRED SAMPLE POPULATION

	Parameter								
Radio-nuclide	DCGL for 25 mrem (dpm/100 cm^2)	LBGR (dpm)	σ_s (dpm)	Δ/σ_s	P_r	$Z_{1-\alpha}$	$Z_{1-\beta}$	N	N+20 %
^{238}U+C	250	125	3	125	1.000	1.645	1.645	14.4	18
Source	Calculated (DandD v2.1.0)	Estimated (½ DCGL)	Estimated (Characteriaztion Data)	Calculated	Table 5.1, MARSSIM	Table 5.2, MARSSIM	Table 5.2, MARSSIM	Calculated	Calculated

2. From the above data, the number of survey points (N), increased by 20% to account for uncertainty in the estimates of σ and P_r, and missing or unusable measurements, is 18. These data points will be divided equally between the survey unit and the reference area. (i.e. m=9 and n=9)

H Areas of Elevated Activity

1. Assuming a Class I survey unit does not exceed 47 m^2, and the number of measurements required for statistical tests is 9, and that a triangular grid pattern is used, then the distance between sample locations is given by:

$$L = \sqrt{\frac{A}{.866 n_{ea}}} = \sqrt{\frac{47}{.866 \times 9}} = 2.81m$$

2. Then the area for elevated measurements not found would be:

$$A_{EMC} = L^2 = 7.90 m^2$$

a. The "area factor" is the magnitude by which the concentration within a small area of elevated activity can exceed the DCGL while maintaining compliance with the release criteria.

b. For Class I survey units of the type evaluated here, the number of samples may be driven more by the need to detect small areas of elevated activity than by the requirements of the statistical tests. Since a given concentration of residual radioactivity spread over a smaller area will, in general, result in a smaller dose or risk, the $DCGL_{EMC}$ used for the elevated measurement comparison is usually larger than the DCGL used for the statistical test.

e. The relationship between $DCGL_{EMC}$ and DCGL is a function of the dose or risk modeling pathways. These are estimated here by computing the ratio of dose or risk per unit concentration generated by RESRAD-BUILD 3.22 for areas of 36 m^2 and 7.90 m^2, otherwise using default values. The results produced an $area\ factor = 7.25$.

f. Since

$$Scan\ \ MDC\ \ (required) = DCGL \times (Area\ \ Factor)$$

Then Scan MDC (required) can be calculated as shown below:

TABLE 7 - REQUIRED MDCSCAN			
Radionuclide	DCGL (dpm/100 cm^2) for 25 mrem TEDE	Area Factor	Scan MDC (required) dpm/100 cm^2
^{238}U+C	250	7.25	1,812

I Calculation of Instrument MDCscan

1. The actual MDCscan for the instrumentation selected has been calculated for the limiting radionuclides potentially present as shown below. For alpha emitting radionuclides, the MDC_{SCAN} is calculated as follows:

For instrument with background count rate of 1 to 3 cpm:

$$P(n \geq 1) = 1 - e^{\frac{-GEd}{60v}}$$

Where

P(n≥1) = The probability of observing a single count
G = Contamination Activity (in dpm)
E = Detector Efficiency (4π)
d = Width of detector in direction of scan (cm)
v = scan speed (cm/s)

Therefore, for ^{238}U+C and with a 25 mrem/year limit, the DCGL is 250 dpm/100 cm^2 which corresponds to 128 dpm/probe surface area. As shown in Table 8, the probability of detecting one count during the monitoring is 95.9%. Since this is greater than 90%, it is an acceptable level of sensitivity.

Table 8 – Alpha MDC_{SCAN} Probability				
G	E	d	v	P(n≥1)
128	0.12	5	2.5	0.959

Once a count is detected, the probe must remain over the same location for time "t" to determine whether a second count will be detected. Time "t" is determined as follows:

$$t = \frac{13{,}800}{CAE}$$

Where
t = time period for static count (s)
C = contamination guideline (dpm/100cm^2)
A = Physical probe area (cm^2)
E = Detector Efficiency (2π)

Table 9 – Alpha MDC_{SCAN} Static Count Time			
C	A	E	t
250	100	0.24	4.49

A second count determined during time t indicates a positive result.

b. This analysis shows that all instruments selected for scanning meet or exceed the required MDC scanning sensitivity requirements.

J Calculation of MDC_{static}

a. The actual MDC_{static} for the instrumentation selected has been calculated for the limiting radionuclides potentially present as shown below. The calculations were made with the RadCalcLE software program, version 1.0, 1999, using the MARSSIM method.

TABLE 10 - INSTRUMENT MDC_{STATIC}							
INSTRUMENT MAKE/MODEL	DETECTOR	ACTIVE AREA	BACKGROUND (CPM)	LD (NET CPM)	RADIO-NUCLIDE	EFFICIENCY (4π)	MDCSTATIC dpm/100cm^2
Ludlum Model 12	43-1	83	2	20	^{238}U+C	12%	**205**

b. The results show that all instruments selected for static measurements meet or exceed the required MDC sensitivity requirements.

K Scanning Coverage Fractions and Investigation Levels

- Scanning is performed to locate small areas of elevated concentrations of residual radioactivity to determine whether they meet the radiological criteria for license termination. Scanning was performed in the survey unit to detect areas of elevated concentrations. Scanning coverage fractions and scanning investigation levels for buildings are shown in Table 11. (This table is based on MARSSIM Roadmap Tables 2 and 5.8.)

Table 11 – Scanning Coverage Fractions and Investigation Levels		
Class	**Scanning Coverage Fraction**	**Scanning Investigation Levels**
1	100 percent	> $DCGL_{EMC}$
2	10 to 100 percent for soil and for floors and lower walls of buildings. 10 to 50 percent for upper walls and ceilings of buildings. Systematic and Judgemental	> $DCGL_{EMC}$ or > MDC_{scan} if MDC_{scan} is greater than $DCGL_w$
3	Judgemental	> $DCGL_{EMC}$ or > MDC_{scan} if MDC_{scan} is greater than $DCGL_w$

- Systematic scans are those conducted according to a preset pattern. Judgmental scans are those conducted to include areas with a greater potential for residual radioactivity. In Class 2 areas, a 10 percent scanning coverage would be appropriate when there is high confidence that all locations would be below the $DCGL_W$. A coverage of 25 percent to 50 percent would be appropriate when there may be locations with concentrations near the $DCGL_W$. A coverage of 100 percent would be appropriate if there is any concern that the area should have had a Class 1 classification rather than

a Class 2 classification. In Class 3 areas, scanning coverage is usually less than 10 percent. If any location exceeds the scanning investigation level, scanning coverage in the vicinity of that location should be increased to delineate the elevated area.

L Evaluation of Survey Results

- All survey units should be evaluated to determine whether the average concentration in the survey unit as a whole is below the $DCGL_W$. If the radionuclide is not present in background and the measurement technique is radionuclide-specific so that comparison with a reference area is not necessary, a one-sample test, the Sign test, should be used.

- When the residual radioactivity contains a radionuclide present in the environment or when the measurements are not radionuclide-specific, the survey unit should be compared to a reference area. When the survey unit will be compared to a reference area, a two-sample test, the Wilcox Rank Sum (WRS) test, should be used.

M ALARA Calculations

a. See Tab A.

N References:

a. NUREG 1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, December 1997.

b. Draft Regulatory Guide DG-4006, *Demonstrating Compliance with the Radiological Criteria for License Termination*, U.S. NRC, August 1998.

c. NUREG - 1757, *Consolidated NMSS Decommissioning Guidance, Decommissioning Process for Materials Licensees*, Vol. 1&2, U.S. NRC, September, 2002.

d. Decontamination and Decommissioning (DandD) software, U.S. NRC, Version 2.1.0

e. Resrad-Build software, U.S. DOE, Version 3.21, September 2002.

f. RadCalcLE, Ludlum Measurements Edition, Version 1.0, ©1999, RSA Publications.

Tab A to Attachment 1

Residual Activity Levels that are ALARA

from NRC Draft Regulatory Guide DG-4006

$$\frac{Conc}{DCGL_w} = \frac{Cost}{2000 \times P_D \times 0.025 \times F \times A} \times \frac{r+\lambda}{1-e^{-(r+\lambda)N}}$$

Calculations made for:

U contamination over an area of "A" m^2 for a cost of "$Cost_T$"
with an effectiveness of "F" in a building scenario.

	$Cost_T$	P_D	F	A	r	λ	N	Conc/DCGLw =
$	**400.00**	**0.09**	**0.8**	**7.9**	**0.07**	**1.55E-10**	**70**	**1.0**

$Cost_T$	Cost for remediation efforts, including transport & disposal of wastes
P_D	Population density (buildings: 0.09 person/m^2)
F	Amount of residual activity removed
A	Size of area (in m^2)
r	Monetary discount rate (0.07/yr for buildings)
λ	Decay constant for radionuclide (y^{-1})
N	Number of years of exposure (Buildings: 70)

Conc — The concentration level at or above which it will be cost effective to perform remediation.

Conc/DCGLw = — The concentration in units of DCGLw
If less than 1, ALARA remediation is usually necessary
if greater than 1, ALARA remediation is usually not required

Note: In this case, if washing/removal of surface contamination was to cost more than $400.00, then the removal activities need not be performed and the results would be ALARA. However, if elevated areas were decontaminated, the results would be ALARA regardless of the effectiveness.
(NRC Draft Reg Guide 4006, 1998, Sec 3.1)

ECOLOGY SERVICES, INC.
10220 OLD COLUMBIA RD.
COLUMBIA, MD 21046
1-800-932-7299
1-410-381-2600
1-410-381-2602 FAX

RADIATION SAFETY SURVEY

COMPANY NAME: **WVU Institute of Technology**

BUILDING: **Engineering Classroom Building**

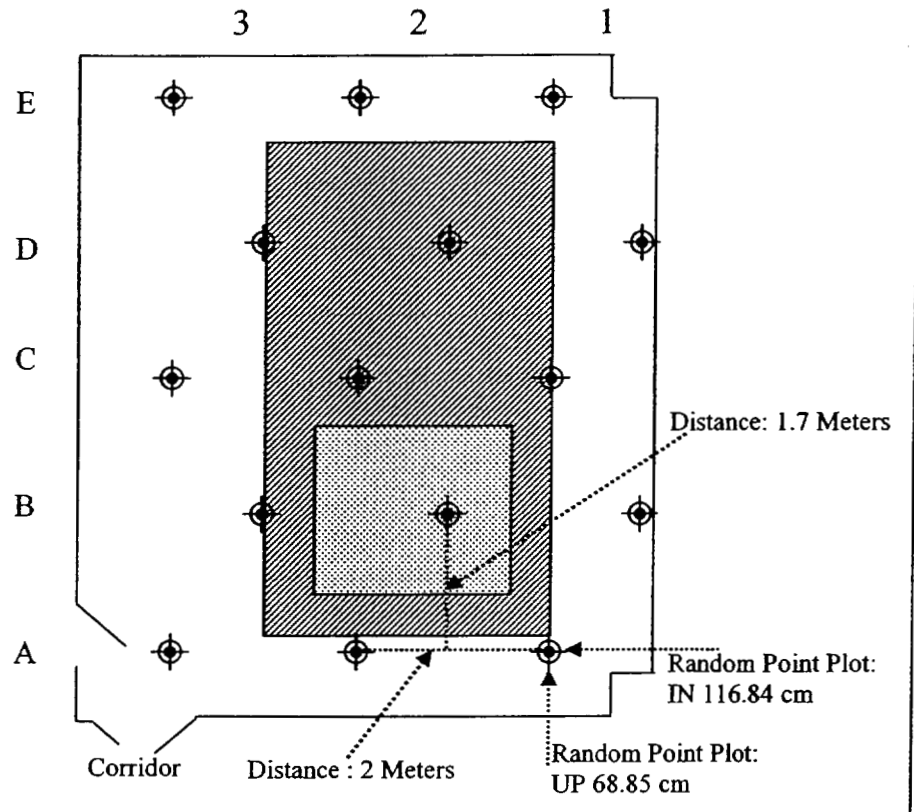
RADIATION SAFETY OFFICER: **MR. STEVE ROOT**

ROOM NO.: **105**

SURVEYOR: HOWETT,GOSNELL

SURVEY DATE: **5/20/05**

AREA DIAGRAM:



INSTRUMENT
MODEL; SN; CALIBRATION DATE; BACKGROUND READING.

Ludlum-12 w/ 43-1; SN: 94204; background = 3.0 cpm

Ludlum-5; 118176; background = 15 µR/hr

SAMPLE ID	ACTION/WIPE SEQUENCE
Floor Wipes:	**1-15**
Wall I	**16-33**
Wall II	**34-49**
Wall III	**50-68**
Wall IV	**69-82**

STATIC MEASUREMENTS WITH 43-1 PROBE:

GRID AREA	GCPM	DPM/100CM^2
(A,1)	3	≤MDA
(A,2)	1	≤MDA
(A,3)	4	10
(B,1)	0	≤MDA
(B,2)	4	10
(B,3)	6	30
(C,1)	3	10
(C,2)	18	150
(C,3)	2	≤MDA
(D,1)	3	≤MDA
(D,2)	0	≤MDA
(D,3)	10	21
(E,1)	2	≤MDA
(E,2)	1	≤MDA
(E,3)	7	40

SUMMARY OF RESULTS:
All wipe sample results were less than the instrument L_D except as noted below. (The instrument L_D is less than 2200 dpm /100 cm^2)

Wipe location/ #	dpm/ 100 cm^2

COMMENTS: TOTAL AREA COVERS 46.8 SQUARE METERS.

Raised surf

Concrete

Original data is available for review upon request at ESI, Columbia, MD, 800-932-7299.

Attachment ***

WRS Test

Scan Data taken with 43-90
(open probe area: 100 cm2)
Efficiency: 11.6%
DCGLw: 250 DPM

$DCGL_W$ (ncpm): 29

	A	B	C	D	E
0	Data (cpm)	Area	Adjusted Data	Ranks	Reference Area Ranks
1	1	R	30	27	27
2	2	R	31	32	32
3	0	R	29	22.5	22.5
4	1	R	30	27	27
5	1	R	30	27	27
6	3	R	32	35.5	35.5
7	3	R	32	35.5	35.5
8	0	R	29	22.5	22.5
9	0	R	29	22.5	22.5
10	5	R	34	39.5	39.5
11	2	R	31	32	32
12	0	R	29	22.5	22.5
13	4	R	33	37.5	37.5
14	4	R	33	37.5	37.5
15	2	R	31	32	32
16	1	R	30	27	27
17	2	R	31	32	32
18	2	R	31	32	32
19	5	R	34	39.5	39.5
20	1	R	30	27	27
21	1	S	1	13.5	0
22	1	S	1	13.5	0
23	1	S	1	13.5	0
24	0	S	0	5	0
25	1	S	1	13.5	0
26	0	S	0	5	0
27	1	S	1	13.5	0
28	0	S	0	5	0
29	0	S	0	5	0
30	0	S	0	5	0
31	0	S	0	5	0
32	2	S	2	19	0
33	0	S	0	5	0
34	2	S	2	19	0
35	2	S	2	19	0
36	1	S	1	13.5	0
37	1	S	1	13.5	0
38	0	S	0	5	0
39	0	S	0	5	0
40	1	S	1	13.5	0
23		Sum =		637	**610**

m = 20
n = 20

Critical value = 471

If the sum of the reference area ranks exceeds the critical value, the null hypothesis is rejected.

ECOLOGY SERVICES INC.

REPORT OF SAMPLE ANALYSIS

Rev 1.3

For:	WVU Tech
Job:	Rm 105 Decommissioning
Sample Type:	Wipe Samples

Date:	12-Jul-05
By:	TWO
Sample Date:	7-Jun-05
Counting Parameters:	Gross Alpha

Equipment Description:
Counter: Ludlum 2200 SCA
Detector: EIC Windowless GFPC

Input Background Data:

Background Cts	Ct Time (m)	Background CF	% Error
3	5	0.60	113.16%

Input Efficiency Data:

Isotope	Gross Counts	Time (m)	DPM	Efficiency (4 Pi)	% Error
239Pu	25220	5	1.06E+04	47.80%	4.00%

MDA Calculation:

MDA (CPM)	MDA (DPM)	MDA (uCi)
2	5	2.086E-06

Sample Data: Note: A zero reading for DPM or pCi/gm values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross Counts	Ct Time (m)	CF	Decay Factor	DPM/Sample	Error at 95% C.L.
1	Floors: Wipe No. 1	1	5	1	1.0	< MDA	N/A
2	2	1	5	1	1.0	< MDA	N/A
3	3	0	5	1	1.0	< MDA	N/A
4	4	2	5	1	1.0	< MDA	N/A
5	5	3	5	1	1.0	< MDA	N/A
6	6	4	5	1	1.0	< MDA	N/A
7	7	3	5	1	1.0	< MDA	N/A
8	8	2	5	1	1.0	< MDA	N/A
9	9	3	5	1	1.0	< MDA	N/A
10	10	3	5	1	1.0	< MDA	N/A
11	11	1	5	1	1.0	< MDA	N/A
12	12	2	5	1	1.0	< MDA	N/A
13	13	1	5	1	1.0	< MDA	N/A
14	14	1	5	1	1.0	< MDA	N/A
15	15	11	5	1	1.0	< MDA	N/A
	"Missed Activity"	5	5	1	1.0	5	N/A

$$MDA(dpm) = \frac{4.65\sqrt{R_b/T_b} + 3}{T_s \cdot Efficiency}$$

Health Physicist

ECOLOGY SERVICES INC

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Rev 1.3

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Sample Data: Note: A zero reading for DPM or pCi/gm values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross Counts	Ct Time (m)	CF	Decay Factor	DPM/Sample	Error at 95% C.L.
1	Wall I: Wipe No. 16	3	5	1	1.0	< MDA	N/A
2	17	1	5	1	1.0	< MDA	N/A
3	18	2	5	1	1.0	< MDA	N/A
4	19	3	5	1	1.0	< MDA	N/A
5	20	2	5	1	1.0	< MDA	N/A
6	21	4	5	1	1.0	< MDA	N/A
7	22	2	5	1	1.0	< MDA	N/A
8	23	1	5	1	1.0	< MDA	N/A
9	24	5	5	1	1.0	< MDA	N/A
10	25	4	5	1	1.0	< MDA	N/A
11	26	0	5	1	1.0	< MDA	N/A
12	27	9	5	1	1.0	< MDA	N/A
13	28	2	5	1	1.0	< MDA	N/A
14	29	2	5	1	1.0	< MDA	N/A
15	30	3	5	1	1.0	< MDA	N/A
16	31	2	5	1	1.0	< MDA	N/A
17	32	0	5	1	1.0	< MDA	N/A
18	33	3	5	1	1.0	< MDA	N/A
	"Missed Activity"	5	5	1	1.0	5	N/A

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Sample Data: Note: A zero reading for DPM or pCi/gm values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross Counts	Ct Time (m)	CF	Decay Factor	DPM/Sample	Error at 95% C.L.
1	Wall II: Wipe No. 34	6	5	1	1.0	< MDA	N/A
2	35	1	5	1	1.0	< MDA	N/A
3	36	3	5	1	1.0	< MDA	N/A
4	37	7	5	1	1.0	< MDA	N/A
5	38	2	5	1	1.0	< MDA	N/A
6	39	2	5	1	1.0	< MDA	N/A
7	40	5	5	1	1.0	< MDA	N/A
8	41	2	5	1	1.0	< MDA	N/A
9	42	1	5	1	1.0	< MDA	N/A
10	43	4	5	1	1.0	< MDA	N/A
11	44	0	5	1	1.0	< MDA	N/A
12	45	0	5	1	1.0	< MDA	N/A
13	46	2	5	1	1.0	< MDA	N/A
14	47	1	5	1	1.0	< MDA	N/A
15	48	1	5	1	1.0	< MDA	N/A
16	49	2	5	1	1.0	< MDA	N/A
	"Missed Activity"	5	5	1	1.0	5	N/A

$$MDA(dpm) = \frac{4.65\sqrt{R_b/T_b} + 3}{T_b \cdot Efficiency}$$

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MDA (CPM)	MDA (DPM)	MDA (uCi)
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Sequence Number	Sample ID	Gross Counts	Ct Time (m)	CF	Decay Factor	DPM/Sample	Error at 95% C.L.
1	Wall III: Wipe No. 50	2	5	1	1.0	< MDA	N/A
2	51	5	5	1	1.0	< MDA	N/A
3	52	1	5	1	1.0	< MDA	N/A
4	53	4	5	1	1.0	< MDA	N/A
5	54	6	5	1	1.0	< MDA	N/A
6	55	0	5	1	1.0	< MDA	N/A
7	56	1	5	1	1.0	< MDA	N/A
8	57	3	5	1	1.0	< MDA	N/A
9	58	2	5	1	1.0	< MDA	N/A
10	59	3	5	1	1.0	< MDA	N/A
11	60	10	5	1	1.0	< MDA	N/A
12	61	0	5	1	1.0	< MDA	N/A
13	62	0	5	1	1.0	< MDA	N/A
14	63	10	5	1	1.0	< MDA	N/A
15	64	0	5	1	1.0	< MDA	N/A
16	65	4	5	1	1.0	< MDA	N/A
17	66	5	5	1	1.0	< MDA	N/A
18	67	1	5	1	1.0	< MDA	N/A
19	68	3	5	1	1.0	< MDA	N/A
	"Missed Activity"	5	5	1	1.0	5	N/A

$$MDA(dpm) = \frac{4.65\sqrt{R_b/T_b} + 3}{T_b \cdot Efficiency}$$

Health Physicist

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MDA (CPM)	MDA (DPM)	MDA (uCi)
2	5	2.086E-06

Sample Data: Note: A zero reading for DPM or pCi/gm values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross Counts	Ct Time (m)	CF	Decay Factor	DPM/Sample	Error at 95% C.L.
1	Wall IV: Wipe No. 69	5	5	1	1.0	< MDA	N/A
2	70	6	5	1	1.0	< MDA	N/A
3	71	3	5	1	1.0	< MDA	N/A
4	72	1	5	1	1.0	< MDA	N/A
5	73	3	5	1	1.0	< MDA	N/A
6	74	1	5	1	1.0	< MDA	N/A
7	75	1	5	1	1.0	< MDA	N/A
8	76	8	5	1	1.0	< MDA	N/A
9	77	8	5	1	1.0	< MDA	N/A
10	78	2	5	1	1.0	< MDA	N/A
11	79	7	5	1	1.0	< MDA	N/A
12	80	3	5	1	1.0	< MDA	N/A
13	81	3	5	1	1.0	< MDA	N/A
14	82	3	5	1	1.0	< MDA	N/A
	"Missed Activity"	5	5	1	1.0	5	N/A

$$MDA(dpm) = \frac{4.65\sqrt{R_b/T_b} + 3}{T_b \cdot Efficiency}$$

Health Physicist

This is to acknowledge the receipt of your letter/application dated

8/9/2005, and to inform you that the initial processing which includes an administrative review has been performed.

☑ AMENDS. SNM-1990
There were no administrative omissions. Your application was assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

☐ Please provide to this office within 30 days of your receipt of this card

---

A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 137512.
When calling to inquire about this action, please refer to this control number.
You may call us on (610) 337-5398, or 337-5260.

NRC FORM 532 (RI)
(6-96)

Sincerely,
Licensing Assistance Team Leader