NRC FORM 313 (4-2008)
10 CFR 30, 32, 33, 34, 35, 36, 39, and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR MATERIALS LICENSE

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LISLE, IL 60532-4352

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ARLINGTON, TX 76011-4125

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1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

[ ] A. NEW LICENSE

[X] B. AMENDMENT TO LICENSE NUMBER 21-16544-01

[ ] C. RENEWAL OF LICENSE NUMBER

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include ZIP code)*

U.S. Department of Commerce/NOAA
4840 South State Road
Ann Arbor, MI 48108

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Lake Michigan Field Station
1431 Beach St., Muskegon, MI 49441
R/V Laurentian

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Kim Kulpanowski

TELEPHONE NUMBER

(734) 741-2074

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSE FEES *(See 10 CFR 170 and Section 170.31)*

FEE CATEGORY | AMOUNT ENCLOSED $

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39, AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

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CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
Stephen B. Brandt, Director GLERL	Steph Brandt	11/24/08

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APPROVED BY				DATE	

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH
Great Lakes Environmental Research Laboratory
2205 Commonwealth Boulevard
Ann Arbor, Michigan 48105-2945

November 21, 2008

Material Licensing Branch
U. S. Nuclear Regulatory Commission, Region III
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4352

Re: Amendment of License No. 21-16544-01

To Mr. Kevin G. Null

The U.S. Department of Commerce/NOAA/Great Lakes Environmental Research Laboratory is requesting that our License No. 21-16544-01 be amended to remove the R/V Shenehon from the listing of restricted areas on our NRC license. All use of licensed material has ended on that vessel and a final status survey has been performed documenting that the vessel may be released for unrestricted use. Two hard copies of the FSS Report, prepared for us by Integrated Environmental Management, Inc. are enclosed.

In addition, we are requesting the vessels the Remorse and Cyclops be removed from our license as well. Radioactive materials were never used on these boats.

Lastly, we request that you amend our license to change our mailing address to the following: U.S. Department of Commerce/NOAA, 4840 South State Road, Ann Arbor, MI 48108.

Thank you for your assistance in this matter. If you have any questions, please call the RSO Kim Kulpanowski at (734) 741-2074.

Sincerely,

Stephen Brandt

Stephen B. Brandt, Director
Great Lakes Environmental
Research Laboratory

Amendment to NRC License 21-16544-01 November 21, 2008

Item 2 Name and Mailing Address of Applicant

Please change our mailing address to the following:

U.S. Department of Commerce/NOAA
4840 South State Road
Ann Arbor, MI 48108

Amendment to NRC License 21-16544-01 November 21, 2008

Item 9 Facilities and Equipment

Please delete the R/V Shenehon, Cyclops, and Remorse from the list of facilities where licensed material will be used. Material has never been used on the Cyclops or Remorse. Material is no longer used on the R/V Shenehon and the Final Status Survey has been performed and is enclosed to document that the vessel can be released for unrestricted use.

Final Status Survey of the Research Vessel Shenehon

Submitted to

US Department of Commerce/NOAA
Great Lakes Environmental Research Laboratory
2205 Commonwealth Blvd
Ann Arbor, MI 48105-2945
(734) 741-2235

by:

Integrated Environmental Management, Inc.
3124 Saddlebrook Drive, Suite 1508
Findlay, Ohio 45840
(419) 423-4701

Report No. 2008016/G-1372
November 14, 2008

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1 INTRODUCTION

The Great Lakes Environmental Research Laboratory, located at 2205 Commonwealth Blvd, Ann Arbor, Michigan (hereinafter referred to as GLERL), maintains radioactive materials License, Number 21-16544-01, issued to the U. S. Department of Commerce/NOAA by the U. S. Nuclear Regulatory Commission. The seagoing research vessel, Shenehon, (RV Shenehon) is listed on the license and is authorized to use radioactive materials.

In order to remove RV Shenehon from the listing of restricted areas on License No. 21-16544-01, the GLERL radiation safety staff must demonstrate that there are no radiological issues of concern therein. To that end, Integrated Environmental Management, Inc. (IEM) was contracted to perform and document a final status survey demonstrating that the RV Shenehon may be released for unrestricted use (i.e., without regard for their radiological constituents).[1]

This report serves to document the radiological status of the RV Shenehon. Included herein is a description of the vessel, a review of the history of radiological operations in the laboratory, a summary of recent radiological conditions, an overview of the project and its objectives, a description of the procedures followed, a listing of all data acquired from the vessel, and a statement in regard to the release status of the RV Shenehon. Representatives of the GLERL were given an opportunity to review and comment on a draft before the publication of this Final Status Survey Report.

[1] IEM is licensed by the Maryland Department of the Environment (MDE License No. MD-31-281-01), a USNRC Agreement State, to perform the types of radiation-related services required for this project. However, the final status survey was performed under the applicable terms/conditions of the GLERL license.

2 HISTORICAL ASSESSMENT

2.1 Facility History

The RV Shenehon is docked at the NOAA field station located at 1431 Beach Road, Muskegon, Michigan. NOAA has operated the vessel since 1980. It was used for environmental and ecosystem research in the Great Lakes and coastal marine environments. It is currently licensed to use radioactive materials for the performance of a variety of fate and transport studies.[2] The work with radioactive materials on the vessel has ceased and the GLERL wishes to release the vessel from the listing of restricted areas on License No. 21-16544-01.

2.2 Facility Description

The RV Shenehon is a sixty-six foot (66 ft) boat with a single room, the laboratory, located behind the bridge. Inside the 14 x 21-foot laboratory are two cabinets and a sink. Entrance to a bathroom is on the starboard side of the laboratory and a hatch to the engine room is on the port side.

The laboratory, consisting of about 294 square feet (ft^2), is where all radioactive materials were secured and used when experiments were completed. Radioactive materials were not routinely stored on the vessel; the radioactive tracers were removed from the vessel, immediately upon returning to port. The laboratory was not equipped with a ventilation system or fan. The sink discharged to a gray water hold-up tank and was pumped out when the vessel was in port. There were no direct discharges to the lake. Radioactive materials were not disposed via the sink.

2.3 Source Term

The GLERL in Ann Arbor was licensed to use a variety of bulk (i.e., unsealed) radioactive materials. However, only Carbon-14 (C-14) and Hydrogen-3 (H-3 or tritium) were ever used on the RV Shenehon.[3] Table 6.1 contains the source term for the vessel.

2.4 Results of Previous Surveys

Routine wipe tests were performed by Authorized Users on selected surfaces in the laboratory at the frequency required by their license. In addition, surveys were performed after each experiment when radioactive tracers were in use.[4] The action level for these surveys was "three times background", meaning any survey result that exceeded this level triggered decontamination and re-survey before the surveillance in that area was deemed complete. The Radiation Safety Officer's records, maintained over the history of the license, show no evidence of significant spills or otherwise large release of radioactive material on the floor.

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[2] US Nuclear Regulatory Commission, *Radioactive Materials License 21-16544-01*, Docket 030-11209, expires on August 31, 2014.

[3] Conversation between Kim Kulpanowski (GLERL RSO) and Bill Thomas (IEM), October 17, 2008.

[4] Conversation between Kim Kulpanowski (GLERL RSO) and Bill Thomas (IEM), October 17, 2008.

3 APPROACH

3.1 Project Organization

For this work, Billy R. Thomas of IEM served as the Project Manager and was responsible for data acquisition and the preparation of this report. Technical review was performed by Carol D. Berger, also of IEM. Appendix 7.1 contains the qualifications of Mr. Thomas and Ms. Berger.

3.2 Release Criteria

The USNRC has established criteria for ensuring that facilities and property that were used for licensed operations present negligible radiological risk to people and the environment once licensed operations cease. The radiation dose limit that the USNRC believes presents negligible risk is published in Title 10, Code of Federal Regulations, Part 20.1402:

> *"Decommissioning with license termination shall be limited to sites considered acceptable for unrestricted release where the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent to an average member of the critical group that does not exceed twenty-five millirem per year (25 mrem/yr), including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)..."*

The level of residual radioactivity permissible on a building surface at the GLERL that would ensure compliance with USNRC's radiation dose objective is designated as the derived concentration guideline level (DCGL) as defined in MARSSIM.[5]

For the purpose of this survey effort, the DCGLs were conservatively set to the screening values presented in Table H.1 of NUREG-1757, Volume 2 and Table 5.19 of NUREG-5512,Volume 3.[6,7] These screening values were established by the USNRC based on an exposure assessment equivalent to 25 millirem per year to a hypothetical critical population for the 1,000-year period after release for unrestricted use. Assumptions designed to maximize the resulting dose were used as input to the assessment.

Table 6.2 contains the DCGLs applicable to the RV Shenehon. For the on-site effort, the data acquired were compared to the lowest applicable DCGL shown in the table. As such, the survey objective was to detect residual radioactivity above the DCGL for C-14, which is 3.7×10^6 dpm (beta)/$100 cm^2$.

3.3 Data Quality Objectives

The objective of the final status survey was to release the RV Shenehon in accordance with guidance established by the USNRC. This objective was accomplished in general by:

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[5] U.S. Nuclear Regulatory Commission, *Multi-agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Revision 1, August, 2000.

[6] U.S. Nuclear Regulatory Commission, *Consolidated Decommissioning Guidance Characterization, Survey, and Determination of Radiological Criteria*, Table H.1, NUREG 1757, Volume 2, Rev 1, September, 2006.

[7] U.S. Nuclear Regulatory Commission, *Residual Radioactive Contamination From Decommissioning - Parameter Analysis*, Table 5.19, NUREG 5512, Volume 3, Draft, October, 1999.

- Selecting the appropriate instrumentation to adequately detect the radionuclides of concern;
- Establishing proper count times and measurement methods to verify that the release criteria are met;
- Performing surveys to verify the radiological status of the facility;
- Verifying that personnel exposure from residual contamination will not exceed 25 mrem/year based on the future use of the facility; and
- Evaluating the data to ensure that sufficient information is collected to release the laboratory for unrestricted use.

In order to ensure the laboratory surfaces meet the applicable release criteria to a reasonable degree of scientific certainty, the following statistical procedures were implemented, including:

- Impacted areas were classified by contamination potential as Class 2 based on the area size, use history and current radiological status (see Section 3.6, below). The survey unit boundary was established within the perimeter of the laboratory as no radioactive materials were ever stored outside of this area.
- Statistical testing was based on the null hypothesis, which states that the residual radioactivity in the survey unit exceeds the site dose criterion.
- The upper bound of the gray region (UBGR) was defined as the DCGL, and the lower bound of the gray region (LBGR) was set at 0.4 x DCGL.[8]
- The Type I decision error was defined as the probability of passing a survey unit that should fail. The Type II decision error was defined as the probability of failing a survey that should pass. Probability limits of 0.05 were assigned for both decision errors.
- The standard deviation was estimated as 0.2 x DCGL.
- The relative shift was set at greater than 1.5.
- The detection sensitivity for all measurement techniques (scan, direct measurements and sample analysis) was normally less than or equal to 75 percent of the DCGL.

3.4 Instrumentation
The radiation detection instrumentation used for this effort was selected and operated according to the type of analysis being performed, and to ensure sensitivities sufficient to detect the identified radionuclides at the minimum detection requirements. Table 6.2 is a list of the instrument types that were used for the RV Shehenon final status survey, along with the types of radiations they detect, and the necessary calibration sources.

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[8] The gray region of a population distribution is the range of possible values for which the consequences of decision errors are relatively minor.

The instrument detection limits are dependent upon count times, geometry, sample size, detector efficiency, background, scanning rate and the efficiency of the surveyor.[9] Nominal detection sensitivities were calculated using the guidance in NUREG 1507 and shown in the following subsections, and are summarized in Table 6.3. The following subsections give the calculation methodologies.

3.4.1 Beta Direct Measurements

The equation used to calculate the minimum detectable activity for direct measurements of beta radiation is:

$$MDA = \frac{\frac{2.71}{t_s} + 3.29\sqrt{\frac{R_b}{t_s} + \frac{R_b}{t_b}}}{E \times \frac{A}{100}}$$

where MDA = Minimum detectable activity (dpm/100cm^2), R_b = Background count rate (cpm), t_b = Background count time (minutes), t_s = Sample count time (minutes), A = Detector area (cm^2), and E = Detector efficiency (counts/disintegration).

3.4.2 Beta Scans

The equation used for calculating the MDA for alpha and beta scans (MDA_{SCAN}) is:

$$MDA_{SCAN} = \frac{d' \times \sqrt{b_i} \times \frac{60}{i}}{E_i \times E_S \times \sqrt{p} \times \frac{A}{100}}$$

where MDA = Minimum detectable activity (dpm/100cm^2), d' = Decision error taken from Attachment 2. (Assumed to be 3.28 for α =0.05 and β=0.95), I = Observation counting interval (detector width divided by the scan speed), b_i = Background count per observation interval, E_I = Detector efficiency, E_s = Surface efficiency (assumed to be 25% for beta contamination on concrete), p = Surveyor efficiency (Assumed to be 50%), and A = Detector area (cm^2).[10,11]

3.5 Survey Unit Classification

Survey units were established in MARSSIM as Class 1, 2, or 3. In general, a Class 1 survey unit is an impacted area where there are expected to be locations with concentrations of residual radioactivity that exceed the DCGL. A Class 2 survey unit is an impacted area, less than 1,000 square meters, where there are expected to be locations with concentrations of residual radioactivity detectable above background levels, but that do not exceed the DCGL. A Class 3 survey unit is an

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[9] U.S. Nuclear Regulatory Commission, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG/CR-1507, December, 1997.

[10] ISO-7503 recommends using a surface efficiency based on the type of radiation and radiation energy in the absence of experimentally derived values. A surface efficiency of 0.25 is recommended for alpha radiation and beta radiation with a maximum beta energy between 150 keV and 400 keV.

[11] International Organization for Standardization (ISO), *Evaluation of Surface Contamination*, ISO 7503, 1988.

impacted areas where there are no expected locations with concentrations of residual radioactivity detectable above background. Impacted areas were those with a potential of being contaminated, that is the laboratory behind the bridge. Non-impacted areas were those that did not have a potential for being contaminated and were not addressed further in the survey effort.

3.5.1 Class 1 Survey Unit

No areas on the RV Shenehon were classified as a Class 1 survey unit for the purposes of this survey effort. There are no recorded incidents of significant spills or releases of radioactive materials over the history of the license, and routine surveillance indicated no laboratory surfaces that exceeded the DCGLs specified in Table 6.2.[12] The radiation surveys previously performed by the Authorized Users and reviewed by the RSO, demonstrated no residual radioactivity above the DCGLs.

3.5.2 Class 2 Survey Unit

The restricted area (i.e., laboratory behind the bridge) was classified as a Class 2 survey unit. The previous surveys performed by the Authorized Users focused on the presence of C-14.[13] While no area was known to be impacted in excess of the DCGLs, this laboratory and walls, less than two (2) meters from the floor, was surveyed pursuant to the requirements for a Class 2 survey unit. The walls in the laboratory at a height greater than 2 meters were designated as Class 3, as well as all overhead areas.

3.5.3 Class 3 Survey Unit

The walkway leading from the hatch of the laboratory to the exit of the vessel was classified as a Class 3 survey unit. It was reported that the deck, including this walkway, was painted over in 2002.[14]

3.6 Survey Procedures

The final status survey of the classified areas consisted of beta scans, fixed beta measurements, and smears that were analyzed by the methodology of liquid scintillation analysis. The following subsections describe the survey procedures.

3.6.1 Surface Scans

For Class 2 survey units, beta scans were performed over approximately 50% of the accessible laboratory surfaces using a calibrated plastic scintillator, equivalent to a Ludlum Model 43-89, while listening to the audible output of the instrument. The detector was maintained at a distance of less than one (1) centimeter from the surface, depending on surface conditions. Scan speeds were established such that contamination at residual radioactivity of no greater than 50% of the applicable release criterion was detectable.[15] The survey results are shown in Table 6.5.

For Class 3 survey units, beta scans were performed over approximately 10% of the surface area. Those areas with the highest potential for elevated residual radioactivity, based on professional

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[12] Conversation between Kim Kulpanowski (GLERL RSO) and Bill Thomas (IEM), October 17, 2008.

[13] Conversation between Kim Kulpanowski (GLERL RSO) and Bill Thomas (IEM), October 17, 2008.

[14] Conversation between Dennis Donahue (NOAA Facility Manager) and Bill Thomas (IEM), October 27, 2008.

[15] The beta energy of the tritium decay, 18 kev, Emax, is not detected by the plastic scintillator, Ludlum Model 43-89. Smears for removable activity were collected to verify that no activity of tritium exceeded the applicable DCGL.

judgement, were selected for scanning. The results for the surface scans are also shown in Table 6.5.

3.6.2 Direct Beta Measurements
Direct (stationary) beta measurements were made on the structural surfaces of each survey unit. Direct measurements were also recorded on the bench tops and cabinets located in the laboratory. Measurements were conducted by integrating the total counts over a count time of two (2) minutes. The instrument-specific background was subtracted and the activity in units of dpm/100cm^2 was calculated. Measurements were made at the nodes of the grids, using a square grid pattern. The results of the direct measurements are shown in Table 6.4 of this report.

3.6.3 Removable Activity Measurements
Smears for removable radioactivity were collected at ten (10) different locations in the laboratory and analyzed for beta radiation by liquid scintillation counting. These results, reported in units of dpm/100cm^2, are shown in Table 6.6 of this report.

3.6.4 Measurement Grid Spacing
Grids were established for the purpose of referencing locations of measurements and sampling, relative to structural and/or site features. The grid spacing for the measurement and samples was determined assuming a square grid pattern as follows:

$$L = \sqrt{\frac{A}{N}}$$

where L = grid spacing, A = Survey unit area (square meters), and N = the number of measurements.

The starting point for the survey was established for each survey unit by selecting a reference point for the survey unit such as the corner of the laboratory. A random number generator was used to provide a random number between 0 and 1 for an initial offset from the reference point in both the x and y coordinates. The random number pair was multiplied by the calculated grid spacing providing the offset from the reference point for the first grid location. The grid dimensions were approximately one meter by one meter, or one square meter.

3.7 On-site Activities
The surveyor mobilized to the site on October 27, 2008. Appendix 7.2 contains a copy of the Field Activity Daily Log maintained by Mr. Thomas. After meeting with the manager of the NOAA field station, checks were performed to verify the instrument response to radiation. Appendix 7.3 contains the instrument records (i.e., calibration certificates and daily checks). Appendix 7.6 contains photographs of selected areas of the RV Shenehon.

The laboratory was cleared of all loose equipment and materials to the maximum extent possible prior to the start of the surveys. The background and detector response checks were documented before the instrument was pressed into use. A data package of results for both direct measurements and removable radioactivity was created. Once all of the data were acquired, they were reduced and compared to the release criteria shown in Section 3.3, above.

4 RESULTS

Once the surveys were complete, data were reviewed to ensure the data quality objectives specified in Chapter 4, above, were met. No discrepancies were identified during data review, thus the data set was deemed valid by both the Project Manager and the Technical Reviewer. The radiation survey data points summarized in Tables 6.4 through 6.5 (see Appendix 7.4 for the Radiation Survey Forms) demonstrate that the residual radioactivity in the restricted area on the RV Shenehon is not distinguishable from background and, in all cases, below the applicable release criteria.

The survey results for the metal deck outside of the restricted area exhibited radioactivity above background established for that area (see Table 6.3). These gross beta radiation levels, although low, were noted on all surfaces of the painted deck, in the walkway, and on other locations on the deck. The manager for the NOAA field station reported that the decking had been painted in 2002, which was after the use of licensed radioactivity on the vessel ceased.[16] Because the slightly elevated count rate was so uniformly distributed over any of the painted surfaces, it is reasonable to assume that the paint itself contained small quantities of radioactivity that are not associated with licensed operations.

Samples (smears) for removable radioactivity were collected and analyzed for low-energy beta radiation by a qualified laboratory using a calibrated, liquid scintillation counter.[17] Ten (10) samples were collected in the laboratory on both the two (2) countertops and the floor. A map showing where each sample was acquired is provided in Appendix 7.4, the results are captured in Table 6.6, and the certificates of analysis from the laboratory are included in Appendix 7.5. No results above background were reported, with the detection levels all well-below the DCGL.

[16] Conversation between Dennis Donahue (NOAA Field Staton Manager) and Bill Thomas (IEM), October 27, 2008.

[17] Stan Huber and Consultants, Inc., *Sample Analysis for 3H and 14C Detection*, November 5, 2008.

5 SUMMARY AND CONCLUSIONS

A final status survey of the RV Shenehon was performed on October 27, 2008. All survey data collected during the on-site portion of the effort were validated and compared to the DCGL for Carbon-14, $3.7x10^6$ dpm/100 cm^2. An adequate number of measurements were made and none exceeded the DCGL, thus the restricted area on the vessel meets the requirements for release for unrestricted use. In fact, the data and measurements demonstrate that residual radioactivity in the classified areas, with one exception, cannot be distinguished from background. The exception is the metal decking outside of the restricted area that was painted over with a product that likely contains trace natural radioactivity. Therefore, and to a reasonable degree of scientific certainty, the RV Shenehon may thus be released for unrestricted use (i.e., for any purpose without regard for radiological concerns) subject to regulatory approval.

6 TABLES

Table 6.1 - Source Term and Derived Concentration Guideline Levels

Radionuclide	Principal Radiation	Radiation Energy, E_{max} (keV)	Derived Concentration Guideline Levels (dpm/100 cm^2)[Note]
Carbon-14	beta	156	$3.7x10^6$
Hydrogen-3	beta	18	$1.2X10^8$

Note : The screening values for unrestricted use of building surfaces are provided in NUREG 1757 and NUREG 5512 such that the potential radiation dose to the critical population is less than 25 millirem per year.[18,19]

[18] U.S. Nuclear Regulatory Commission, *Consolidated Decommissioning Guidance Characterization, Survey, and Determination of Radiological Criteria*, Table H.1, NUREG 1757, Volume 2, Rev 1, September, 2006.

[19] U.S. Nuclear Regulatory Commission, *Residual Radioactive Contamination From Decommissioning - Parameter Analysis*, Table 5.19, NUREG 5512, Volume 3, Draft, October, 1999.

Table 6.2 - Survey Instrument Descriptions

Make	Rate Meter Model	Detector Model	Detector Type	Radiation Detected[20]	Calibration Source	Use
Ludlum	2224	43-68	Plastic Scintillator	Beta, 65-1,450 Kev	^{99}Tc	Direct beta surveys; Beta scan on solid surfaces
Packard	NA	NA	Liquid scintillation	Beta, 5-1,500 Kev	^{14}C and ^{3}H	Wipe test analysis

[20] U.S. Nuclear Regulatory Commission, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG/CR-1507, December, 1997.

Table 6.3 - Survey Instrument Detection Limits

Detector Model	Background(1)	Detector Efficiency (c/dis)(2)	Sensitivity ($dpm/100cm^2$)	
			Scanning	Static Count
43-89	Floor Tile 181.0±41.9 cpm βγ	0.14 βγ	2,481	335 (2 min count)
Liquid Scintillation	17.5 cpm	0.94 ^{14}C 0.65 ^{3}H	n.a.	8.6 dpm ^{14}C 9.7 dpm ^{3}H (5 min count)

(1) Average of the beginning of shift and end of shift values over the course of the survey effort.
(2) Average of the daily efficiencies over the course of the survey effort.

Table 6.4 - Stationary (Static) Count Results

Location	Number of Static Counts[Note 1]	MDA dpm/100 cm² (β-γ)	Highest Static Readings dpm/100 cm² (β-γ)
Top of cabinet, port side	10	335.5	103.6±70.6
Top of cabinet, starboard side	10	335.5	17.9±68.4
Floor, port side	10	335.5	67.9±69.7
Floor, center of laboratory	10	335.5	71.4±69.7
Floor, starboard side	10	335.5	128.6±71.3
Wall, port side	10	335.5	82.1±70.1
Wall, starboard side	10	335.5	67.9±69.7
Walkway outside of laboratory, port side	6	335.5	596.4±82.1[Note 2]
DCGL for carbon-14			3.7×10^6

Note 1: Direct measurements were made on locations as described above. The radiation measurement was completed using a Ludlum Model 43-89 plastic scintillator (100cm² in sensitive area). A count duration of two (2) minutes was used for each measurement. The original data are provided in Appendix 7.4.

Note 2: The metal deck outside of the laboratory exhibited a radiation background that was greater than the background detected on the floor tile and recorded in Table 6.3. The gross beta radiation levels were similar on all surfaces on the painted deck. The manager for the NOAA field station reported that the decking had been painted in 2002, after the period where radioactive tracers were used on the vessel.[21] The pigments in the paint were assumed to contain naturally occurring radioactive materials and the source of the elevated readings. No further investigation was deemed necessary.

[21] Conversation between Dennis Donahue (NOAA Field Station Manager) and Bill Thomas (IEM), October 27, 2008.

Table 6.5 - Scan Results

Location[Note 1]	MDA dpm/100 cm² (β-γ)	Highest Scanning Readings dpm/100 cm² (β-γ)
Top of cabinet, port side	2,481.2	144
Top of cabinet, starboard side	2,481.2	144
Floor, port side	2,481.2	144
Floor, center of laboratory	2,481.2	144
Floor, starboard side	2,481.2	144
Wall, port side	2,481.2	144
Wall, starboard side	2,481.2	144
Walkway outside of laboratory, port side	2,481.2	790[Note 2]
DCGL for carbon-14		3.7×10^6

Note 1: 100% of the surfaces were scanned using a Ludlum Model 43-89 plastic scintillator ($100 cm^2$ in sensitive area). The countrates ranged from 130 - 150 cpm and the instrument background was determined to average 130±20 cpm. No hot spots were detected. A survey map is provided in Appendix 7.4.

Note 2: The metal deck outside of the laboratory exhibited a radiation background that was greater than the background detected on the floor tile and recorded in Table 6.3. The gross beta radiation levels were similar on all surfaces on the painted deck. The manager for the NOAA field station reported that the decking had been painted in 2002, after the period where radioactive tracers were used on the vessel.[22] The pigments in the paint were assumed to contain naturally occurring radioactive materials and the source of the elevated readings. No further investigation was deemed necessary.

[22] Conversation between Dennis Donahue (NOAA Field Station Manager) and Bill Thomas (IEM), October 27, 2008.

Table 6.6 - Removable Activity Survey Results

Sample Number	Location	Sample Detection Limit dpm	Smear Result dpm/100 cm^2 H-3[Note]	Smear Result dpm/100 cm^2 C-14
101	Cabinet top, port side	9.7	0.0±11.0	2.5±10.4
102	Cabinet top, port side	9.7	0.0±11.0	2.3±10.4
103	Floor, center	9.7	0.0±11.0	1.6±10.3
104	Floor, center	9.7	0.0±11.0	0.0±9.9
105	Floor, center	9.7	0.0±11.0	4.6±10.8
106	Floor, starboard side	9.7	0.0±11.0	4.5±10.8
107	Cabinet top, starboard side	9.7	0.0±11.0	0.4±10.0
108	Cabinet top, starboard side	9.7	0.0±11.0	0.0±9.9
109	Floor, port side	9.7	0.0±11.0	3.9±10.7
110	Walkway, outside of laboratory	9.7	0.0±11.0	2.0±10.5

Note: See Appendix 7.4 for a map of smear locations. Each sample was analyzed by an off-site laboratory using a calibrated liquid scintillation counter with two regions of interest, Region A with energy ranging from 0 -12 kev (Hydrogen-3) and Region B ranging from 12 to 156 kev (Carbon-14).[23] See Appendix 7.5 for the analytical results. Each sample was counted for 5 minutes.

[23] Stan Huber and Consultants, Inc., *Sample Analysis for 3H and 14C Detection*, November 5, 2008.

7 APPENDICES

Appendix 7.1 - Qualifications of Project Personnel

Billy R. Thomas

Professional Qualifications

Mr. Thomas has over 29 years of senior-level experience in radiological and industrial hygiene activities with emphasis on systems to minimize personnel exposures to radioactive and hazardous materials, compliance with federal and state regulations, site and facility audits. Mr. Thomas has developed and implemented comprehensive programs for radiation and chemical protection programs. Mr. Thomas is actively involved in all aspects of health and safety including regulatory compliance, site decommissioning, program evaluation, applied health physics, occupational safety, training and project management.

Education

M.S., Environmental Health, University of Oklahoma, 1981

B.S., Health Physics, Oklahoma State University, 1976

Certifications

Certified Health Physicist (Comprehensive Practice), American Board of Health Physics, 1988. Recertified: 2004.

Certified Industrial Hygienist (Comprehensive Practice), American Board of Industrial Hygiene, 1984. Recertified : 2007.

OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training. Initial training 1987 and updated each year.

Lead Abatement Training for Supervisors, University of Cincinnati. 1996.

Asbestos Abatement Supervisor Course, Asbestos Consulting and Training Systems, 1997.

Authorized User - Maryland Department of the Environment Radioactive Materials License No. MD-31-281-01.

Experience and Background

2002-Present *Vice President, Consulting Division, Integrated Environmental Management, Inc. Findlay, Ohio.* As the director of the company's consulting division, Mr. Thomas is responsible for selecting and coordinating the services of senior-level consultants in the areas of radiation safety and industrial hygiene. In addition, he maintains and ensures all members of the division maintain a track record of technical excellence, cost and schedule control, and innovation in solving environmental and health/safety problems for both government and commercial clients.

2008-Present *Adjunct Instructor, College of Science, University of Findlay, Findlay, Ohio.* Serves as instructor for Environmental, Safety and Occupational Health Management program in the College of Science. Presents classes for both the graduate and undergraduate in topics related to safety management and industrial hygiene.

1999-2002 *Senior Health Physicist, Integrated Environmental Management, Inc. Findlay, Ohio.* Provides high-quality radiation protection services to commercial and government clients. As a member of the client's response team, works with clients to promote an understanding of what is required to achieve and/or maintain compliance in the eyes of all pertinent regulatory agencies, individually or jointly; develop and overall strategy for achieving compliance and reduce liabilities in a technically-sound, legally defensible, and fiscally-conservative business manner; recommend specific solutions that are compatible with the client's operating philosophy; and provide insights into future regulatory issues and their impact as input to the client's long-range business planning and cost forecasting process.

Mr. Thomas served as the task manager to develop a baseline human heath risk assessment for a confidential client who previously processed enriched uranium and manufactured fuel pellets. The risk assessment was developed for potential exposures both hazardous chemicals and radioactive materials found in soil and groundwater. The assessment incorporated the requirements of the USEPA Risk Assessment Guidance for Superfund (RAGS) as well as requirements established by the State authorities.

Mr. Thomas developed a Emergency Response and Preparedness Manual for a Canadian client who manufactured uranium pellets for nuclear power reactors. The manual was prepared in accordance with the guidance provided by the Canadian Nuclear Safety Commission (CNSC) and the U.S. Nuclear Regulatory Commission (USNRC). The manual addressed the resources to mobilize to an emergency, involving both hazardous chemicals and radioactive uranium in several different chemical forms. The manual was implemented by the client and approved by the CNSC.

A commercial client, licensed by the Nuclear Regulatory Commission, required an evaluation of their internal dosimetry program. Mr. Thomas prepared a procedure to measure both internal and external exposure. The procedure satisfied the recommendations established by the NCRP and ANSI as well as requirements established by the USNRC.

Mr. Thomas worked as part of a project team to develop decommissioning plans for six (6) different facilities licensed to process radioactive materials. The decommissioning plans established the derived concentration guidelines levels for a variety of radioactive isotopes, including enriched uranium, thorium and byproduct radioactive materials. The potential exposures to future residents were limited to less than twenty-five millirem per year and evaluated over a period of 1,000 years. The plans were compliant with the requirements established by the USNRC and NUREG 1757. Each plan was approved by the USNRC and implemented by the client in order to decommission the facility and terminate the license.

A commercial client required a plan to survey, remediate and ultimately release the building surfaces for unrestricted use. Mr. Thomas established the release criteria using and developed a procedure to complete the radiation survey. The procedure was consistent with the requirements established by the USNRC and NUREG 1575, MARSSIM.

Mr. Thomas completed radiation surveys to evaluate potential exposures to electromagnetic frequency (EMF) radiation in commercial manufacturing facilities.

The evaluation of personal exposures were compared to recommendations published by the ACGIH and OSHA. Recommendations were provided to the clients to limit personnel radiation exposures and verify that exposures were acceptable.

1993-1999 *Director of Health and Safety, The IT Group, Findlay, Ohio.* Originally joined OHM Remediation Services in 1993. The IT Group purchased OHM in 1998. Duties including conducting site and facility health and safety audits, determination of personal protective equipment and respiratory protection equipment, supervising the development and implementation of site specific health and safety plans, and providing industrial hygiene training and services. He had direct accountability for health and safety compliance, including regulatory compliance with federal, state and local agencies. He implemented a comprehensive health and safety program for demolition and remediation activities by the Midwest region, which accumulated 2.3 million man-hours from March, 1994 to July, 1997 without a sing1e 1ost time injury.

Safety and Health Manager, Kansas City PRAC II, Kansas City District. Duties on this HTRW contract included the development of safety and health plans as well as procedures to be implemented at each of the KC PRAC projects. Developed SSHP for specific KC PRAC projects including, Ottawa, Illinois, Galena, Kansas, Mead Nebraska, and Fort Riley, Kansas. Mr. Thomas provided specific support on the KC PRAC projects including:

Project CIH, Project CHP, Ottawa Radiation Sites, Ottawa, Illinois September 1994 – August 1997. Developed the site specific health and safety plan and radiation protection plan to excavate soil contained radioactive radium generated by a luminous processing company. This project involved the excavation of radioactive contamination from nearby residences and selected sites in the city. Worked with State of Illinois and the EPA to implement an effective contamination control program, including air sampling and personnel monitoring for radium. Provided radiation worker training for the work crew and directed the on-site health physics and industrial hygiene program for the initial phases of the project. Conducted site inspections and project audits on a periodic basis.

Safety and Health Manager, USACE, Omaha District Rapid Response II. Duties on this HTRW contract included the development of program procedures and policies to work on multiple USACE projects. Developed SSHP for specific Rapid projects, including work at Joliet, Illinois, Ames, Iowa and Des Moines, Iowa. Mr. Thomas conducted site inspections and provided technical support for the implementation of the site safety and health program for RR/IR task orders. Mr. Thomas provided support on each Rapid project, including:

Project CIH, Project CHP; Ames Laboratory Chemical Disposal Site, Ames, Iowa. July 1994 – November 1994. Developed the site specific health and safety plan for the excavation and disposal of approximately 1,000 cubic yards of radioactive uranium wastes and contaminated soils. Developed the radiation protection program to be implemented by project employees to reduce exposures to ionizing radiation to as low as reasonable achievable. Contaminated materials were packaged and shipped for disposal in Clive, Utah.

Safety and Health Manager, USACE, TERC Number 1. Duties on this contract included the development of SSHP for work at Ellsworth AFB in Rapid City SD and KI Sawyer AFB in Michigan. Mr. Thomas provided support for some of the TERC projects including:

Project CIH, Ellsworth AFB, OU2 and OU7, Rapid City South Dakota. November 1996 – September 1997. Developed the site specific health and safety plan to excavate radioactive materials from disposal trenches at OU2 and OU 7. Developed radiation protection plan as well as the release criteria to be implemented to document that the site was free of contamination. Worked with the USAF Radiation Safety Committee to establish protocols to identify plutonium in soil and verify that debris was handled correctly.

Project CIH, Tarracorp Industries, Granite City, Illinois April, 1993 – May, 1997. USACE Omaha PRAC II. Developed the site specific safety and health plan for this project to excavate and treat lead-contaminated soil from smelter emissions. Treatment was completed by stabilizing the soil using a pugmill. This process delists the soils to a "special waste" classification, resulting in key cost savings in disposal. To date, over 300 residential sites have been remediated, and over 100,000 tons of soil have been processed. Excavation, transportation, and disposal of wastes containing battery chips have also taken place. Developed the elements of the air monitoring program. The air monitoring program was sufficient to evaluate the personnel exposures to airborne lead dust, as well as the fugitive emission from the exclusion zone. Performed periodic site visits to review results of the air sampling program and confirm that exposures were acceptable.

Health and Safety Manager, Department of Energy, Weldon Spring Site Remedial Action Program (WSSRAP), April 1993 – July, 1995. OHM was contracted to excavate contaminated construction debris from the WSSRAP quarry. Materials in the quarry were accumulated from a munitions manufacturing facility at Weldon Spring, as well as the demolition of buildings from the Mallinckrodt site used during the Manhattan project. Personnel exposures to uranium and thorium were documented, as well as nitroaromatics and asbestos. Mr. Thomas completed site inspections to evaluate the effectiveness of the health and safety plan and review the results of employee exposure monitoring.

Health and Safety Manager during the demolition of selected manufacturing buildings at the WSSRAP. The demolition projects involved the controlled demolition of nine buildings. Employees encountered radioactive uranium as well as asbestos containing materials and cadmium based paints. Mr. Thomas evaluated the construction safety program as well as industrial hygiene program during the demolition tasks.

Health and Safety Manager during the remediation of facilities at the Piketon Gaseous Diffusion Plant in Portsmouth, Ohio. OHM was contracted to remediate a chromic acid tank, including the removal of the lead liner in Building X700. OHM also demolished the incinerator in Building X705A. Mr. Thomas prepared the health and safety plan to document the methods necessary to reduce employee exposure to hazardous materials, both chemical and radiation exposures. OHM employees encountered hot environments in Building X700 where chromic acid and uranium were present.

Health and Safety Manager during the remediation of mixed waste that was buried in several burial pits at the Ames Laboratory in Ames, Iowa. Mr. Thomas participated in the planning and execution of the project, including presentations at the public hearings that were provided by the DOE to the public. The waste in the burial pits contained a variety of hazardous materials, including radioactive uranium, thorium, and asbestos as well as volatile organics including methyl ethyl ketone and trichloroethylene. Mr. Thomas prepared the health and safety plan for the project which described the industrial hygiene practice, the construction safety requirements, and the elements of the health physics program. Mr. Thomas evaluated the controls that were implemented and verified that employee exposures were reduced to as low as reasonably achievable.

1990-1993 *Health and Safety Manager, IT Corporation, St. Louis, Missouri.* Provided direction day-to-day for laboratory operations in the areas of health physics, industrial hygiene, hazardous waste management, and laboratory safety. Served as the Radiation Safety Officer for the USNRC Broad Scope license for the use of by-product and source material at the laboratory .

Collateral assignment as Department Manager of a radiochemistry laboratory to analyze samples from a variety of commercial and government facilities, including facilities operated by the DOE. Services were provided to a variety of DOE facilities including Fernald, Idaho National Energy Laboratory, Lawrence Livermore National Laboratory, Nevada Test Site, Oak Ridge National Laboratory, Paducah Gaseous Diffusion Plant, Rocky Flats, WSSRAP, and the Y12 Production Facility. Supervised the analysis of various environmental media to be analyzed for specific radioactive isotopes including uranium, plutonium, thorium, and radium. Other analyses were performed for fission products and gross methods including alpha and beta analysis. Served as the RSO for the broad-scope license issued to the laboratory by the NRC.

Performed waste management assessment for four different DOE facilities. Principal investigator for hazardous and mixed waste policies, procedures and practices. Recommended program changes and upgrades. Worked at the following facilities, including: Portsmouth Gaseous Diffusion Plant, Piketon, Ohio; K25 Gaseous Diffusion Plant, Oak Ridge, Tennessee; Paducah Gaseous Diffusion Plant, Paducah, Kentucky; and Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Served as project manager for the Industrial Hygiene department at Los Alamos National Laboratory (HSE-5). Responsibilities included reviewing and making recommendations for several of the programs being implemented by HSE-5for the National Laboratory. These programs included asbestos controls, carcinogen control, sampling strategies and hazardous waste site characterization. Mr. Thomas also developed a sampling strategy to evaluate personnel exposures to hazardous materials. Mr. Thomas evaluated the asbestos management program at Los Alamos Laboratory. He reviewed the work performed by the IH department, including project oversight and air monitoring. He inspected work sites established by contractors including Pan American Services to assess compliance with LANL procedures and OSHA regulations.

Served as project manager to prepare mixed waste and radiative waste management plans and programs for waste generated during the remedial investigation at the Nevada Test Site. The programs required coordination between the Remedial Investigation contractor, the DOE Operations Area office and the facility receiving the waste for disposal.

1988-1990 *Director of Corporate Health and Safety, Burlington Environmental, Columbia, Illinois.* Responsible for designing and implementing health and safety programs to limit exposures to hazardous chemicals and radioactive material during sampling and remediation activities. Developed procedures and conducted training classes for field service personnel to correctly use personal protective equipment and perform air monitoring to evaluate personnel exposures.

Mr. Thomas also served on several audit teams to review the health physics programs at DOE site, including Rocky Flats, Los Alamos and the Nevada Test Site. The criteria for the audits were based on the DOE Technical Safety Appraisal objectives. Mr. Thomas worked with the program personnel to correct deficiencies and measure the effectiveness of the programs.

Member of Technical Advisory Group for Martin-Marietta Energy Systems. The Advisory Group provided oversight of the Federal Facility Agreement regarding the operation of the Low Level Radioactive Waste Tank Systems implemented for Oak Ridge National Laboratory. Made recommendations to implement standard industry practices for the purposes of reducing personnel exposures to hazardous and radioactive materials. Reviewed the elements of the industrial hygiene relating to the engineering controls and administrative controls implemented to reduce exposures to hazardous materials. Evaluated the effectiveness of the health physics programs for the purposes of reducing personnel exposures to radiation to as low as reasonably achievable.

Mr. Thomas reviewed the industrial hygiene and health physics programs being implemented at each facility. Used the Technical Safety Appraisal guidelines developed by DOE to critique the effectiveness of the programs begin implemented. Worked with each respective program managers, responsible for the H&S program, to develop an action plan to upgrade the program and track the progress of the changes.

Member of the Management Advisory Team for Martin Marietta Energy Systems Gaseous Diffusion Plants. The Advisory team reviewed the effectiveness of the Health and safety programs being implemented including the health physics and industrial hygiene programs. The Advisory Group was responsible for reviewing each of the health and safety programs and making recommendations for areas of improvement.

1983-1988 *Senior Health Physicist, IT Corporation, Oak Ridge, Tennessee.* Provided health physics and industrial hygiene consulting to government and commercial clients. Served as the project manager for several remedial decontamination projects involving hazardous and radioactive materials. His experience included:

Project CIH, Fernald Feed Materials Production Center, US Department of Energy Cincinnati, Ohio. May, 1987 – June, 1988. Performed health-and-safety review of engineering improvements at DOE uranium metals production facility. Improvements included new ventilation systems, radioactive materials handling systems, and decontamination of the facility. Recommended health physics and industrial hygiene controls to minimize worker's exposure, and updated air monitoring programs for both workplace exposures and effluent sampling.

Task Manager, Fernald Feed Materials Production Center, US Department of Energy Cincinnati, Ohio. August, 1985 – June, 1986. Mr. Thomas developed and implemented the collection and analysis of radiation measurement to assess the concentration of uranium in the soil surrounding the manufacturing facility. This work was performed as part of the site wide Remedial Investigation/ Feasibility study.

Health Physics Supervisor, Joliet, Illinois, Commonwealth Edison, September, 1984 – December, 1985. Provided support for the chemical cleaning of the primary cooling system at Dresden Nuclear Power Station, Unit 1. Mr. Thomas was responsible for assessment of engineering controls to reduce personnel exposures to radiation. The techniques were successful to remove more than 750 curies of cobalt-60 and other activation corrosion products. Personnel exposures were less than 7 man-Rems for the total project.

Health Physics Supervisor, Confidential Client, August 1983 - July, 1984. Provided support to decommission a facility that manufactured neutron sources (Am-Be) for nuclear power plants and radiography applications. The hot cells and glove boxes were segmented and packages in Type B shipping containers; the TRU waste shipped to Idaho Falls for storage and ultimate disposal by the USDOE. Drums of remote handled TRU were repackaged and characterized in order to satisfy the waste acceptance criteria for the USDOE. All work was performed in containments designed to minimize the spread of radioactive contamination, both airborne and surface contamination. Exposures to remediation workers was maintained below 1,000 millirem per person for the 15 month project; external exposures to gamma and neutron radiation were minimized. Internal exposures to TRU, including plutonium and americium were evaluated and verified to satisfy the requirements of the USNRC.

1976-1983 *Senior Research Industrial Hygienist, Dow Chemical, Midland, Michigan and Tulsa, Oklahoma.* Provided health and safety support for employees in manufacturing facilities, including plastic and other intermediate chemical production. Assigned as lead health physicist for decontamination projects at several nuclear power plants. From 1977 to 1980, Mr. Thomas served as the radiation safety officer for a NRC broad scope license to authorize the use of mixed fission products and special nuclear material used in manufacturing and research applications at Dow Chemical. The program included a TRIGA reactor, two small accelerators, sealed radioactive sources and tracers for a variety of research programs. Mr. Thomas directed all elements of the health physics program including training, standard operating procedures, exposure assessment and documentation. Mr. Thomas later (1981 - 1983) served as the radiation safety officer for the field services division where sealed sources and mixed fission products were used in treatment systems. This assignment had responsibilities in 22 states for approximately 3,000 employees. Mr. Thomas directed the use of radioactive materials licenses in 16 different states and a NRC license for the use of these radioactive materials.

Professional Society Membership

Health Physics Society (Plenary member)

American Academy of Health Physics

American Industrial Hygiene Association

American Academy of Industrial Hygiene

Bibliography

Mr. Thomas has authored/coauthored many papers and technical reports. In addition, he has developed/presented training courses in the field of health physics, industrial hygiene and safety.

Other Appointments/Awards

Ohio Radiation Advisory Council. Appointed by Governor Taft in 2002. Elected Chair of the Council each year from 2004 through 2008. Appointment expires in 2010.

Ohio Utility Radiological Safety Board, Citizen's Advisory Council. Elected Chair in 2001 and 2002.

Member of the Working Group for the ANSI/HPS N43.8 Standard, *Classification of Industrial Ionizing Radiation Gauging Devices*, 2006-2008.

Director of the State of Ohio Low Level Radioactive Waste Facility Development Authority Board. Appointment by the Speaker of the Ohio State Legislature in 1997.

Chairman's Award for Safety Excellence, OHM Remediation Services, 1996, 1997

Senior Technical Associate, International Technology Corporation, 1991.

Member of the People to People Ambassador Delegation visiting the People's Republic of China, 1987. Invited speaker to review health physics practices.

Carol D. Berger - Technical Reviewer

Professional Qualifications

Ms. Berger has over 30 years experience in nuclear and radiological activities with emphasis in strategic planning, radiation dosimetry, instrumentation, and applied health physics. As a co-founder of Integrated Environmental Management, Inc. (**IEM**), Ms. Berger is actively involved in performance of radiological dose assessments, regulatory interactions, site decommissioning, program evaluations, program development, pathway analyses, risk assessments, dosimetry evaluations, assessment and control of sources of non-ionizing radiations, waste management programs, environmental monitoring programs, and detection and quantification of low-levels of radioactivity.

Education

M.S., Health Physics, San Diego State University, San Diego, California; 1979

M.S., Radiation Physics, San Diego State University, San Diego, California; 1977

B.S., Physics/Chemistry, San Diego State University, San Diego, California; 1972

Certifications

Certified Health Physicist (Comprehensive), American Board of Health Physics, 1983 (Re-certified through 2011)

Alternate Radiation Safety Officer - Maryland Department of the Environment Radioactive Materials License No. MD-31-281-01.

Authorized User - Maryland Department of the Environment Radioactive Materials License No. MD-31-281-01.

Radiation Health Physicist Registration - Cabinet for Health Services, Commonwealth of Kentucky, Certificate No. 3013.

Maryland Department of the Environment - Service Registration No. 358-000.

U. S. Department of Energy "Q" Security Clearance (*expired*).

Experience and Background

1994-Present *President and Founder, Integrated Environmental Management, Inc., Gaithersburg, Maryland.* Provides high-quality strategic environmental management services to commercial and government clients. As a member of the client's response team, works with clients to promote an understanding of what is required to achieve and/or maintain compliance in the eyes of all pertinent regulatory agencies, individually or jointly; develop an overall strategy for achieving compliance and reduce liabilities in a technically-sound, legally-defensible, and fiscally-conservative business manner; recommend specific solutions that are compatible with the client's operating philosophy; and provide insights into future regulatory issues and their impact as input to the client's long-range business planning and cost forecasting process.

1989-1994 *Senior Technical Consultant, IT Corporation/Nuclear Sciences, Washington, D.C.* - Performed health physics consulting for government and commercial facilities in Internal and External Dosimetry; Radiation Monitoring; Environmental Monitoring; Instrumentation; Emergency Response and Preparedness; Site Decommissioning; Radioactive Waste Management; Radiation Risk Assessment; Training; Licensing and Regulatory Negotiations; and Non-ionizing Radiation

1986-1989 *Senior Health Physicist, IT Radiological Sciences Laboratory, Knoxville, Tennessee* - Performed health physics consulting for government and commercial facilities in Internal and External Dosimetry; Radiation Monitoring; Environmental Monitoring; Applied Health Physics; Instrumentation; Radioactive Waste Management; Training; and Non-ionizing Radiation.

1983-1986 *Radiation Dosimetry Group Leader, Oak Ridge National Laboratory, Oak Ridge, Tennessee.* Responsible for internal and external dose assessment and programs for ORNL employees, visitors and contractors. Experience included Internal and External Dose Assessment; Monitoring Program Design and Implementation; Instrumentation Development; Site Characterizations; Personnel Management; and Training.

1978-1983 *Internal Dose Group Leader, Oak Ridge National Laboratory, Oak Ridge, Tennessee.* Responsible for development of the ORNL Whole Body Counter Facility for detection and quantification of the actinides in-vivo. Experience included: Internal Dose Assessment; Monitoring Program Design and Implementation; Instrumentation Development; Special Studies; Personnel Management; and Training.

1978-1986 *Adjunct Faculty, Oak Ridge Associated Universities, Oak Ridge, Tennessee* - Professional training courses and general classes in the following health physics and radiation protection areas: Internal Dose Assessment; In-vivo Monitoring and Bioassay Methodologies; Instrumentation, and Applied Health Physics.

1979-1980 *Health Physics and Dosimetry Task Group Member, President's Commission on the Accident at Three Mile Island, Washington, D.C.* Tasks included: Internal Dose Assessment from Whole Body Counting Results; Estimates of Source Term from in-plant Monitoring Systems; Atmospheric Dispersion Modeling and Population Dose Assessment; and Development of Health Physics Sequence of Events.

Professional Society Membership

American Academy of Health Physics (President, 1995; Executive Committee, 1995-1997; Chair of Strategic Planning Committee, 1997; Chair of Professional Standards and Ethics Committee, 2003-2006)

National Council on Radiation Protection and Measurements (Program Area Committee 2 on Operational Radiation Safety, 2008-2011)

Health Physics Society (Fellow Member, 2006; Publications Committee, 1999-2001)

Baltimore-Washington Chapter, Health Physics Society (Treasurer, 1993-1994, Board of Directors, 1998-2000)

American Bar Association (Natural Resources, Energy, and Environmental Law)

Environmental Law Institute

Publications

Over 30 professional publications; over 40 oral presentations; over 100 technical reports; over 25 training courses taught.

Other/Past Appointments/Awards

American Academy of Health Physics - Third recipient of the *Joyce B. Davis Memorial Award* for professional achievement and ethical behavior in the practice of health physics (July, 2006, Providence, Rhode Island).

East Tennessee Chapter - Health Physics Society (President, 1986; President-Elect, 1985; Secretary, 1981-1982).

San Diego Chapter - Health Physics Society (Charter member).

American Board of Health Physics, Comprehensive Panel of Examiners (1989-1993).

ANSI Standards Committee (ANSI N13.41) on Multiple Dosimetry; Chair of Reaffirmation Working Group (2007 to present).

ANSI Standards Committee (ANSI N13.41) on Multiple Badging; 1986 to 1996 (Chairman, PlanCo-59 Working Group, 1990 to 1996).

ANSI Standards Committee (ANSI N13.39) on Internal Dosimetry Programs (1994 to 2001).

ASTM Task Group E-10.04.27 "Transuranic Wound Analysis" (1986 to 2000).

National Council on Radiation Protection and Measurements (NCRP) Scientific Committee 46-10, "Assessment of Occupational Exposures from Internal Emitters" (1989-1995).

Purdue University, Health Sciences Advisory Council for the School of Health Sciences (1995-1998).

DOE/IAEA Whole Body Counter Intercalibration Committee (1980-1986).

Consultant to Knoxville Academy of Medicine, Mass Casualty Simulation (1984-1985).

Consultant to the National Cancer Institute to Evaluate Devices and Techniques to Determine Previous Radiation Exposure under Public Law 98-54 (Award for participation presented by Oak Ridge Associated Universities in April, 1988.).

Steering Committee Member, U. S. Department of Energy Task Group on the Education of Future Health Physicists (1989-1991).

Technical reviewer and referee for Health Physics, Nuclear Technology, and Radiation Protection Management.

IT Corporation Distinguished Technical Associate - June, 1992.

Appendix 7.2 - Field Activity Daily Logs

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
FIELD ACTIVITY DAILY LOG

Facility: Great Lakes Env Research Laboratory NOAA		
Date: 10/27/2008	Time: 0710	Job/Task Number: 2008016.01
Client Name: Dennis Donahue		
Address of Work Site: 1431 Beach Road Muskegon, MI		
Description of Work: Final Status Survey		

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

0710 Arrive at office. Met w/ Dennis Donahue. Can't start survey on boat until sunrise. Check instruments. Check background and instrument response to Tc-99 check source

0815 Access to boat approved. Performing radiation survey in laboratory behind bridge. Scanned all exposed surfaces floor, cabinets, vertical walls

0940 Surface scan complete. No hot spots identified. Start direct measurements

1120 Finished survey. Reviewed results w/ Dennis Donahue

1130 Left site

Ship commissioned 1952
NOAA began use of boat 1980
Used tritium from 1990-1998
deck painted 2x after tritium used

Changes from Plans and Specifications, and Other Special Orders and Important Decisions: No changes	
Weather Conditions: Sunny 48°F	Important Telephone Calls and Interactions: None
Personnel on Site: Bill Thomas	
Name (print): Bill Thomas	Signature: Bill Thomas

Appendix 7.3 - Instrumentation Records

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
INSTRUMENT RESPONSE CHECK

Location: Muskegon MI	**Meter Model No.:** 2224	**Probe Model No.:** 43 89
Check Source No.: Tc 99 2399-98	**Meter Serial No.:** ~~125690~~ BA 125607	**Probe Serial No.:** PR 132117
Scaler Count Time (Min): 2 min	**Response Switch:** slow	**Name:** Bill Thomas

Meas. Number	Radiation Type (check): ☐ Alpha ☒ Beta ☐ Beta/Gamma				Radiation Type (check): ☐ Alpha ☐ Beta ☐ Beta/Gamma			
2 min	Background (counts ~~per minute~~) BA	$(x - x_{ave})^2$	Check Source (counts ~~per minute~~)	$(x - x_{ave})^2$	Background (total counts)	$(x - x_{ave})^2$	Check Source (total counts)	$(x - x_{ave})^2$
1	335	729	5881	26569				
2	373	121	5600	13924				
3	416	2916	5726	64				
4	377	225	5737	361				
5	381	361	5577	19881				
6	336	676	5759	1681				
7	323	1521	5702	256				
8	355	49	5764	2116				
9	376	196	5685	1089				
10	348	196	5750	1024				
Sum $a = (x-x_{ave})^2$	6990		66965					
Mean $b = (x_{ave})$	362		5718					
σ^2 $c = a \div [n - 1]$	699		66974					
σ $d = c^{½}$	93.7		258.8					
2σ $e = 2 \times d$	167.3		517.6					
3σ $f = 3 \times d$	251.1		776.4					

Acceptable Check Source Ranges			Notes/Calculations:
Range	~~Alpha~~	Beta	Tc99 20,000 dpm 9/10/98 DNS-12
2σ	~~___ to ___~~	___ to ___	
3σ	~~___ to ___~~	___ to ___	Completed 10/27/2008

$x_{Avg} = 362$

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 2224 SERIAL# 125607

Owner: IEM

DATE: 02/07/08 LOCATION: Griffin Inst

TECH: Joanne Glenn DATE LAST CAL EXPIRES: 03/05/08

Reason For Calibration: (•) Due For Calibration ( ) Repair (See Remarks)

( ) Other (See Remarks) ( ) Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500 SERIAL #: 114512 CAL. DUE: 12/20/08

MODEL: SERIAL #: CAL DUE:

✔ Fast/Slow Switch working properly ✔ Audio Response ✔ Geotropism CABLE LENGTH: 39"

CONDITION: Sat AF MECHANICAL ZERO: 0 AL MECHANICAL ZERO: 0

NEW BATTERIES: (•) Yes ( ) No BATTERY CHECK: Sat

HV	AS FOUND HV	AS LEFT HV	WINDOW SETTINGS:	A.F.	A.L.
500 V:	500	A.F.	BT (3.5 mV +/- 1 mV):	3.5	A.F.
1000 V:	1000	A.F.	BW (30 mV +/-3 mV):	30	A.F.
1500 V:	1475	A.F.	AT (120 mV +/-10 mV):	120	A.F.

RATE METER / SCALER

SCALE	RATE CPM	AS FOUND	% ERROR	AS LEFT	% ERROR	AS FOUND (Scaler)	% ERROR	AS LEFT	% ERROR
x.1 or x1	100	100	0.0%	A.F.					
	250	250	0.0%	A.F.		250	0.0%	A.F.	
	400	400	0.0%	A.F.					
x1 or x10	1000	1000	0.0%	A.F.					
	2500	2500	0.0%	A.F.					
	4000	4000	0.0%	A.F.					
x10 or x100	10K	10 K	0.0%	A.F.					
	25K	25 K	0.0%	A.F.					
	40K	40 K	0.0%	A.F.					
x100 or x1000	100K	100 K	0.0%	A.F.					
	250K	250 K	0.0%	A.F.					
	400K	400 K	0.0%	A.F.					

Is the As Found Data Within 20% of the Set Point?: (•) Yes ( ) No

Overload Light: (•) Adjusted ( ) Not Adj Low Battery (2.2 V): (•) Sat ( ) Unsat

REMARKS: Calibrated w/43-89 #PR132117

Does Instrument Meet Final Acceptance Criteria?: (•) Yes ( ) No

Calibration Sticker Attached?: (•) Yes ( ) No

Date Instrument Is Due For Next Calibration: 02/07/09

Performed/Reviewed by: *Joanne Glenn* Date: 2/7/2008 Entered by: *[initials]* Initials

Calibrations performed to ANSI N323A-1997 standards

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 43-89 PROBE # PR132117

Owner: IEM

DATE:	02/07/08	LOCATION:	Griffin Inst
TECH:	Joanne Glenn	DATE LAST CAL EXPIRES:	03/22/08

REASON FOR CALIBRATION:

Due For Calibration Repair (See Remarks) Other (See Remarks) • Due and Repair

CABLE LENGTH: 35" INPUT SENSITIVITY: 10 mV

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL:	2241	SERIAL #:	143562	CAL. DUE:	02/07/09
MODEL:		SERIAL #:		CAL. DUE:	

NIST TRACEABLE SOURCES USED

SOURCE #:	Other	SOURCE #:	99-1816
ISOTOPE:		ISOTOPE:	Cs137
ACTIVITY(dpm):		ACTIVITY:	1.23 uCi
ASSAY DATE:		ASSAY DATE:	08/12/99

Condition: • Sat Unsat Efficiency from last cal.: Pu: 19.31% Tc Ni: 18.76% Th: 17.85% C-14:

	HV	Vernier		
Setpoints from last cal.:	775	N/A		
Source	**Alpha Response CPM**	**Beta Response CPM**		
Background:				
Pu-239:			A-B XTLK:	
Tc-99 Ni:			B-A XTLK:	
As Found Efficiencies Pu, Tc:				
Th-230 / C-14	/		/	
Background:	0	277		
Pu-239:	3606	558	A-B XTLK:	7.2%
Tc-99 Ni:	9	3404	B-A XTLK:	<1%
As Left Efficiencies Pu, Tc:	19.49%	16.99%	27.19%	
Th-230 / C-14	5101 /		17.00% / 33.56%	

Is as found efficiency within 20% of the efficiency from the last cal? Yes • No (See Remarks)

Note: If the as found data is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the plateau section and go directly to remarks.

GRIFFIN INSTRUMENTS

PROBE #: **PR132117**
Date: 02/07/08

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
N/A										

Alpha / Beta Bkg (cpm) 0 277

HV / Vernier		**Pu-239**	**Tc-99 Ni**	**Tc-99 SS**	**Th-230**	**C-14**	**Sr-90**
775	**CPM:**	3606	3404	4052	5101		3190
	4 pi AL Efficiencies:	**19.49%**	**16.99%**	**10.12%**	**17.00%**		**28.89%**
	2 pi AL Efficiencies:	***38.40%***	***27.19%***	***16.20%***	***33.56%***		***41.32%***

Other NIST sources: Th-230 Source #99TH470-1815 4/11/06 30,000 dpm Pu-239 Source #2696-00 7/18/06 18,500dpm
Tc-99 on Stainless Steel Source #99TC470-1814 8/3/99 37,300 dpm, Sr90 Source #2697-00 3/1/00 12,200 dpm

REMARKS: Replaced mylar due to off scale as found data. Calibrated w/2224 #125607.

Does Instrument Meet Final Acceptance Criteria?: • Yes No

Calibration Sticker Attached?: • Yes No

Date Instrument Is Due For Next Calibration: 02/07/09

Performed/Reviewed by: [signature] **Date:** 2/7/2008 **Entered by:** [initials] **Initials**

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.

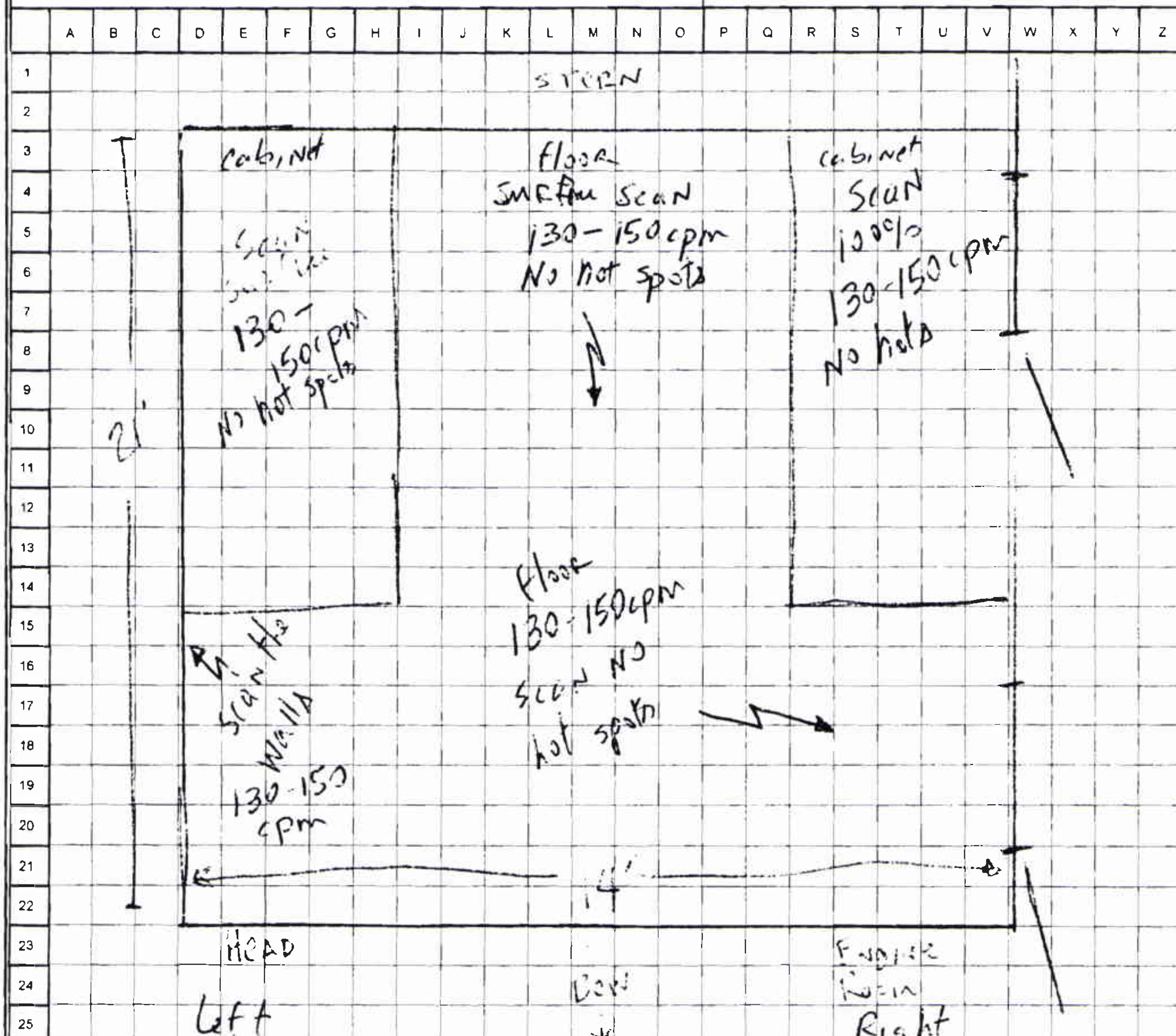
Appendix 7.4 - Survey Records

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number 2008016 - 01

Instrument/SN: 2224 125607	Calibration Due:	Site Name: She Nelson	Date:	Time:
Instrument/SN 43-89 PR 132117	Calibration Due:	Location: Muskegon MI	12/27/08	
Instrument/SN	Calibration Due:	Purpose: Final Status Survey		
Survey Performed By (Signature): [illegible]		Survey Checked By (Signature):		
X Battery OK X HV OK X Source Check OK		Grid Dimensions: Not to x Scale ☐ meters ☐ feet ☐ inches ☐ centimeters		



Notes: 100% scan of all exposed surfaces. No hot spots

Instrument Range 130-150 cpm scanning

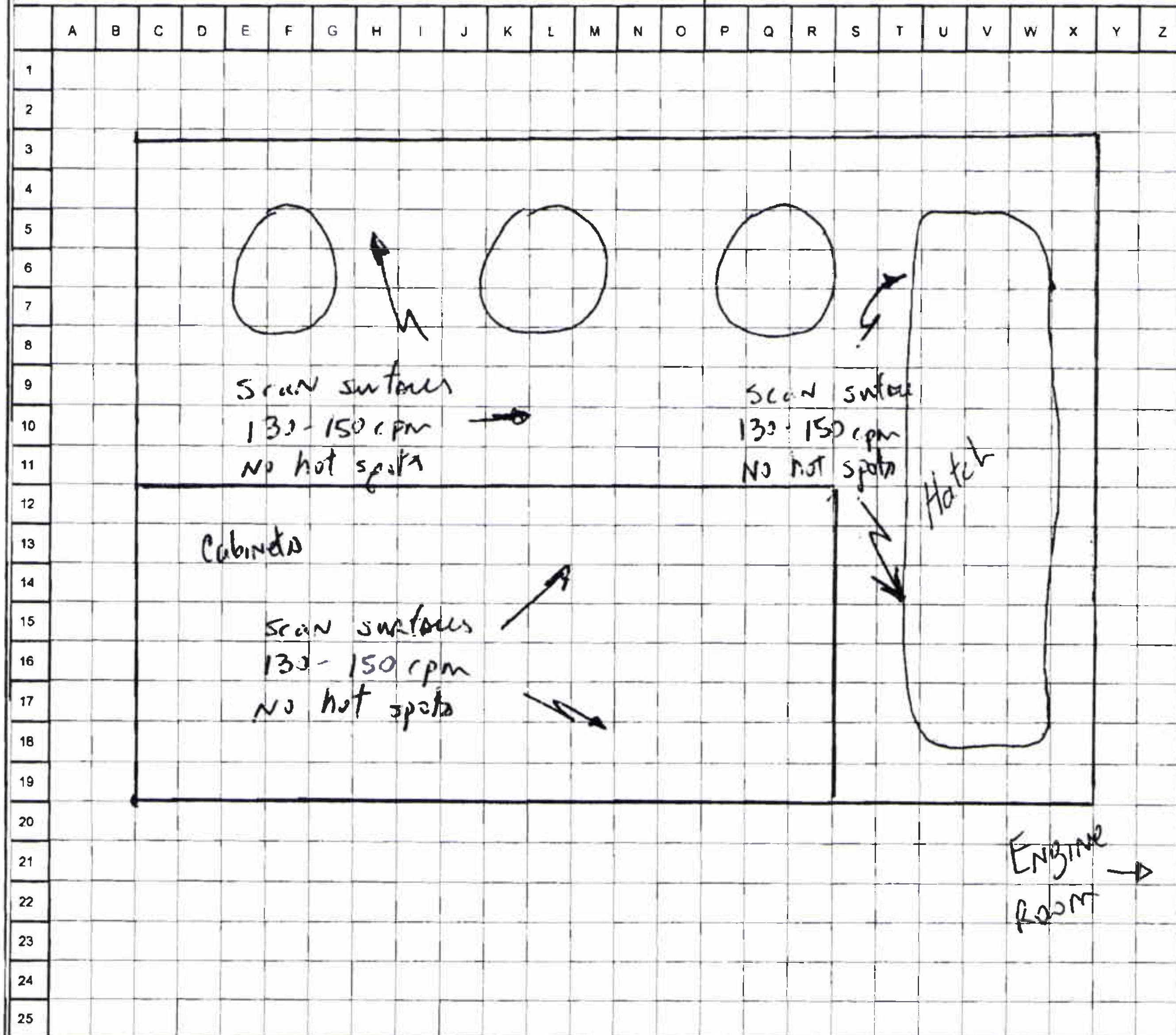
NOAA-R 6501

Instrument bkgd 130-150 cpm

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number 2008016-02

Instrument/SN: 2224 125607	Calibration Due:	Site Name: Shenehon	Date:	Time:
Instrument/SN 4393 132117	Calibration Due:	Location: MUSKEGON MI		
Instrument/SN	Calibration Due:	Purpose: FINAL STATUS SURVEY		
Survey Performed By (Signature): Bill Thomas		Survey Checked By (Signature):		
☒ Battery OK ☒ HV OK ☒ Source Check OK		Grid Dimensions: NOT TO SCALE ☐ meters ☐ feet ☐ inches ☐ centimeters		



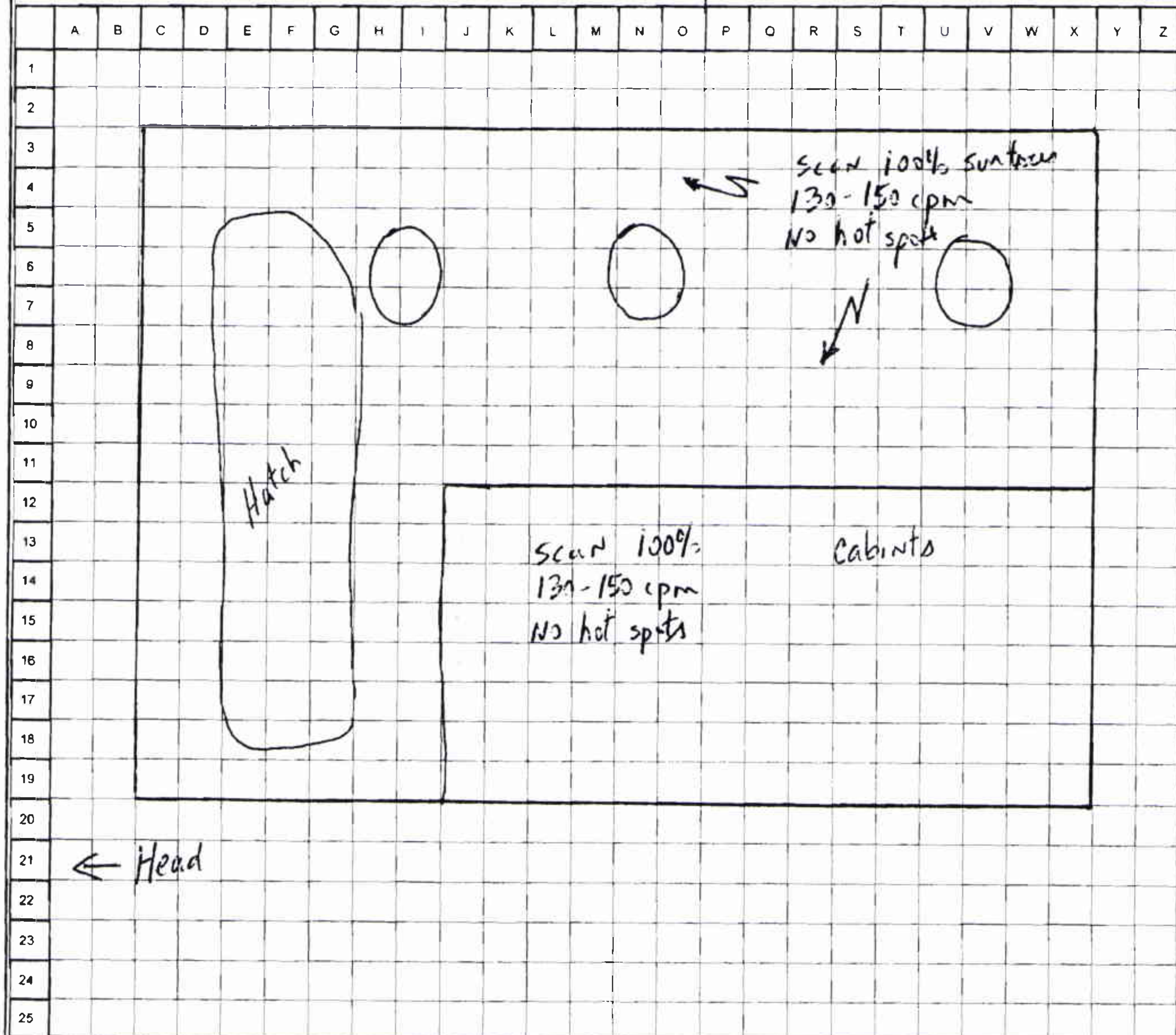
Notes: Right wall

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number 2008016-03

Instrument/SN: 2224 125607	Calibration Due:	Site Name: Shenehon	Date: 10/27/08
Instrument/SN 4397 132117	Calibration Due:	Location: Muskegon MI	Time:
Instrument/SN	Calibration Due:	Purpose: Final Status Survey	
Survey Performed By (Signature): Bill Thomas		Survey Checked By (Signature):	
☒ Battery OK ☒ HV OK ☒ Source Check OK		Grid Dimensions: ____ x ____ ☐ meters ☐ feet ☐ inches ☐ centimeters	

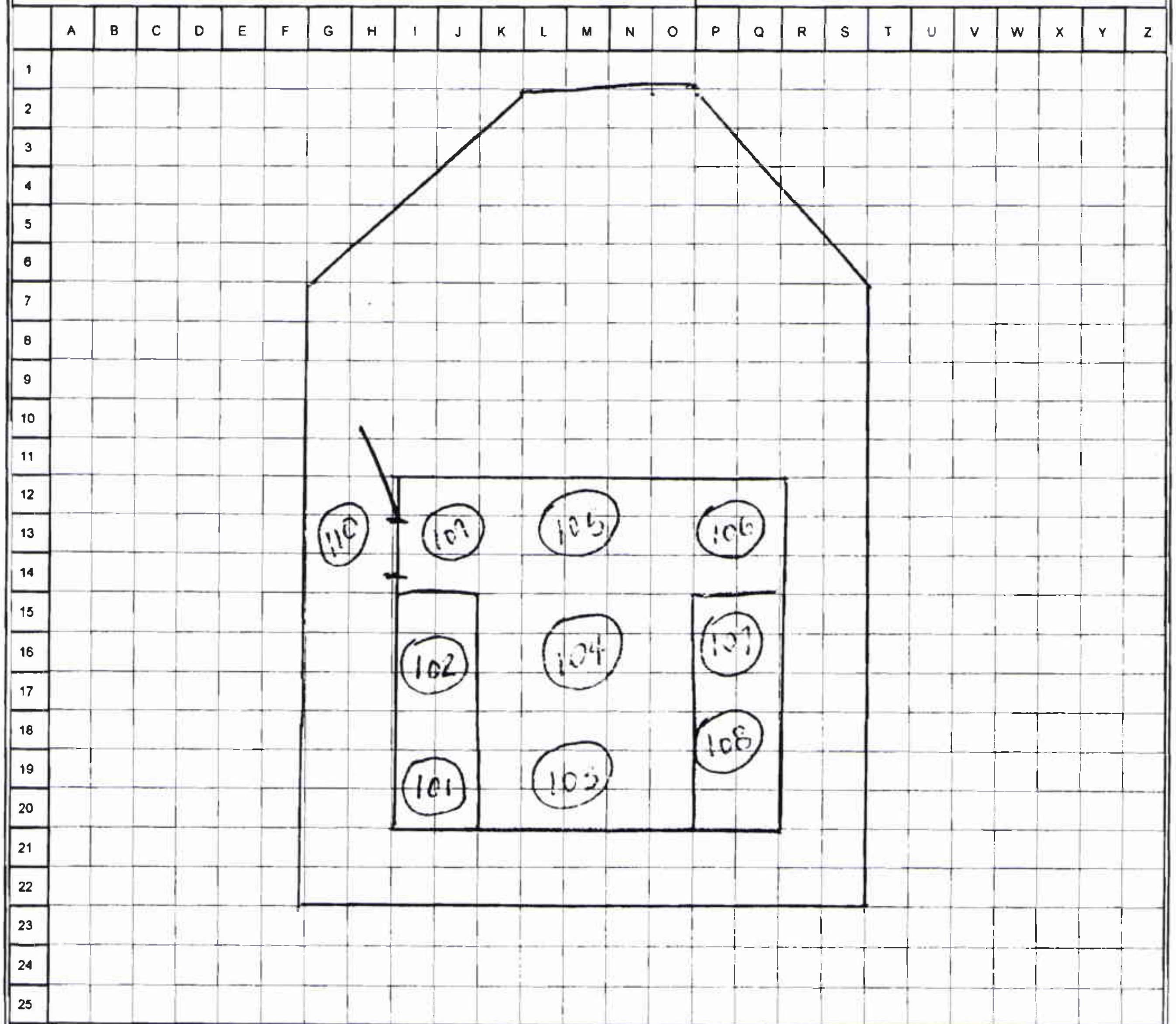


Notes: Left wall

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number______________ Page 4 of 5

Instrument/SN:	Calibration Due:	Site Name: Shenehon	Date:	Time:
Instrument/SN	Calibration Due:	Location: Muskegon MI	10/27/2008	
Instrument/SN	Calibration Due:	Purpose: Final Status Survey		
Survey Performed By (Signature): Bill Thomas		Survey Checked By (Signature):		
☐ Battery OK ☐ HV OK ☐ Source Check OK		Grid Dimensions: ______ x ______ ☐ meters ☐ inches ☐ feet ☐ centimeters		



Notes: Wipe Test locations

Counts/2 min

IEM
Integrated Environmental Management, Inc.

Project No: 2008016.01		Page 5 of 5	
Subject: FINAL Status Survey			
Performed by: Bill Thomas		Date: 10/27/2008	
Checked by:		Date:	

RT cabinet top	Left cabinet top	walkway to exit outside lab
391	362	476
385	338	468
352	322	437
356	367	529
372	358	490
338	374	497
349	360	
380	322	
348	334	
342	348	
	365	

Right Floor	center floor	Left floor	Drum port side
355	362	378	
369	373	349	
381	348	372	
332	378	322	
380	323	398	
365	356	327	
358	370	361	
345	355	338	
349	382	347	
388	323	381	

DIRECT Measurements

Ludlum 2224 125607
9389 PR 132117

IEM
Integrated Environmental Management, Inc.

Project No:	Page 6 of
Subject: FINAL STATUS SURVEY	
Performed by: Bill Thomas	Date: 10/27/08
Checked by:	Date:

Right wall	Left wall
356	381
322	348
338	372
362	385
332	334
355	349
370	380
385	352
365	342
352	349
port side	starboard side

Ludlum 2224 125607

4389 PR 132117

direct measurements
2 min count each
location

Appendix 7.5 - Certificates of Analysis

sahci

200 North Cedar Road – New Lenox, Illinois 60451-1751 – (800) 383-0468 or (815) 485-6161 – FAX (815) 485-4433 – Email sahci@sahci.com – Home Page www.sahci.com

November 5, 2008

Carol D. Berger
President
Integrated Environmental Management, Inc.
8 Brookes Avenue, Suite 205
Gaithersburg, MD 20877

Subject: Sample Analysis for ^{3}H and ^{14}C Detection

Dear Ms. Berger:

Per your request we have completed the analysis of the initial wipes that you provided. All samples were analyzed on November 5, 2008 using a Packard Liquid Scintillation Counter, Model U1900, Serial No. 101464. Each sample was counted for five (5) minutes. The DPM results are provided on the attached document.

If you have further questions or need additional information please feel free to contact me or Glenn Huber at 1-800-383-0468.

Sincerely,
Stan Huber Consultants, Inc.

James Hatten
Radiation Safety Officer, SAHCI

Enclosure

IEM Wipe Analysis
11/5/2008

Instrument Identification:	Manufacturer	Model	Serial	Analyze Date	BKG H3 cpm	BKG C14 cpm	H3 Eff	C14 Eff
LSC	Packard	U1900	101464	11/5/2008	10.11	17.49	0.649	0.9429

Protocol Information: H3 Window: 0-12keV, C14 Window: 12-156keV, Count time: 5 minutes

Sample #	H3 DPM	C14 DPM
101	0.00	2.46
102	0.00	2.30
103	0.00	1.61
104	0.00	0.00
105	0.00	4.59
106	0.00	4.45
107	0.00	0.40
108	0.00	0.00
109	0.00	3.86
110	0.00	2.01

```
SYSTEM NORMALIZED
C14 IPA DATA PROCESSED - 05-Nov-2008 10:49
   C14 Eff (0-156 keV) = 94.29 %
H3 IPA DATA PROCESSED - 05-Nov-2008 10:50
   H3 Eff (0-18.6 keV) = 64.90 %
BKG IPA DATA PROCESSED - 05-Nov-2008 11:50
   Bkg (0-18.6 keV) = 17.25 cpm
   Bkg (0-156 keV)  = 25.52 cpm
   C14 E^2/B (1-156 keV)   = 444.21
   H3  E^2/B (1-18.6 keV)  = 245.81
```

Protocol #:14 Name:3H/14C 05-Nov-2008 12:01
Region A: LL-UL= 0.0-12.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region B: LL-UL=12.0-156. Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region C: LL-UL= 0.0- 0.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Time = 5.00 QIP = tSIE/AEC ES Terminator = Count
Conventional DPM
Nuclide 1 = 270100 Nuclide 2 = 120500

S#	TIME	CPMA	DPM1	CPMB	DPM2	tSIE	FLAG	C:2S%	LUM
1	10.00	10.11		17.49		452.	B	0.00	5
(1 missing vial)									
3	5.00	0.00	0.00	1.82	2.46	250.		0.00	4
4	5.00	0.00	0.00	1.70	2.30	237.		0.00	6
5	5.00	0.00	0.00	1.20	1.61	271.		0.00	5
6	5.00	0.00	0.00	0.00	0.00	276.		0.00	7
7	5.00	0.00	0.00	3.36	4.59	212.		0.00	2
8	5.00	0.00	0.00	3.30	4.42	275.		0.00	6
9	5.00	0.00	0.00	0.30	0.40	285.		0.00	14
10	5.00	0.00	0.00	0.00	0.00	269.		0.00	8
11	5.00	0.00	0.00	2.86	3.86	242.		0.00	11
12	5.00	0.00	0.00	2.01	2.64	340.		0.00	9
(1 missing vial)									
14	5.00	0.00	0.00	0.00	0.00	465.		0.00	4

Appendix 7.6 - Photographs


Cabinet (port side of restricted area)


Pier at the Muskegon Field Station


Cabinet (starboard side of restricted area)


Caginet (port side of restricted area, facing bow)


Cabinet (port side of restricted area)


Cabinet (starboard site of restricted area)


Bridge, facing stern


Restricted area floor, facing stern


Direct (stationary) survey on the floor

Stern view of Shenehon


NOAA Muskegon Field Station


Direct (stationary) survey of painted deck

Bridge view of Shenehon

From: Origin ID: ARBA (734) 741-2074
Kim Kulpanowski
GLERL
2205 Commonwealth Blvd

Ann Arbor, MI 48105

FedEx Express

E

JCLS111208/20/23

Ship Date: 25NOV08
ActWgt: 1.0 LB
CAD: 3743495/INET8091
Account#: S *********

Delivery Address Bar Code

SHIP TO: (630) 829-9500 **BILL SENDER**

Kevin Null
US Nuclear Regulatory Commission
2443 WARRENVILLE RD STE 210
MATERIAL LICENSING BRANCH
LISLE, IL 60532

Ref #
Invoice #
PO #
Dept #

WED - 26NOV A2

TRK# 0201 7961 4022 6074 **STANDARD OVERNIGHT**

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